

INSTRUCTION MANUAL

FREQUENCY EXTENDER MODEL SG-1001

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MODEL SG-1001**

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Instruction Manual No. 110-5094

Serial No. _____

SINGER
INSTRUMENTATION

THE SINGER COMPANY • ELECTRONIC PRODUCTS DIVISION

Creative Products for Test, Measurement, Analysis, Calibration

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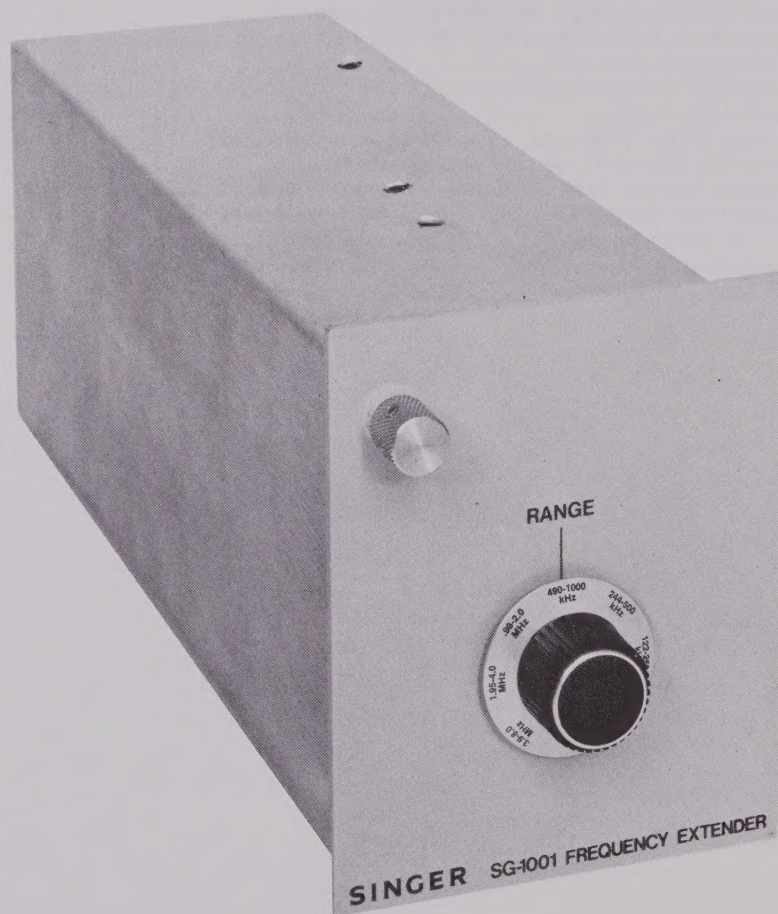


Figure 1-1. Model SG-1001 Frequency Extender

SECTION I INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This manual provides operating and maintenance instructions for the Model SG-1001 Frequency Extender (hereafter referred to as the Extender), manufactured by the Singer Company, Electronic Products Division. This manual also includes general information, installation, theory of operation, maintenance data, schematic diagrams, and a repair parts list. The Extender is illustrated in figure 1-1.

1-3. The information contained in this manual refers to the standard version of the Extender and is current only to the date of publication. Differences in equipment components, specifications, and performance resulting from The Singer Company's continuous production improvement program or individual customer design and application requirements are described in addendum sheets.

1-4. PURPOSE AND USE OF EQUIPMENT.

1-5. The SG-1001 is a plug-in unit which extends the lower limit of the frequency range of the SG-1000 Signal Generator to provide continuous frequency coverage down to 61 kHz in 7 ranges. Measurements of high frequency communications circuits may be performed with the SG-1000 Signal Generator and the SG-1001 Extender. All the capabilities of the SG-1000 are retained except for the pulse and video modulation modes, which are not practical at these low frequencies. Typical applications of the Extender include the following:

- a. Aligning and testing AM communication receivers.
- b. High-level testing of amplifiers, mixers, multipliers.
- c. Multipole filter response characteristics.
- d. Accurate, stable measurement of attenuators.
- e. Determining receiver signal-to-noise ratio.

1-6. GENERAL DESCRIPTION.

1-7. The Extender is a compact, solid-state plug-in unit that extends the operating range of the Model SG-1000 Signal Generator. The operating frequency range is extended from 7.75 MHz down to 61 kHz in seven continuous, overlapping ranges. All of the operating features and capabilities of the SG-1000 are maintained at the extended ranges with the exception of pulse and video modulation. These are not provided since they are not practical at the lower frequency octaves. Except for selection of the extended frequency octave, complete operational performance is controlled by the SG-1000 panel controls. This includes tuning, modulation, attenuation, and monitoring on the associated readout devices. Thus the overall flexibility, operating convenience, and high level of accuracy of the SG-1000 have been maintained at the Extender frequency ranges. All interface connections between the Extender and the SG-1000 are made automatically when the Extender is inserted in the SG-1000 plug-in well.

1-8. The Extender consists mainly of a seven-stage binary divider, amplifiers and modulation circuits. The divider develops sub-multiples of the 7.75 to 16 MHz input frequency from the SG-1000 to cover the extended frequency range. The selected frequency, processed as CW or amplitude modulated, is filtered, leveled, detected, and returned to the SG-1000, where monitoring readouts and output attenuation are provided. Components of the Extender are mounted on eight printed circuit boards and on the rear of the front panel. Operating power for the Extender is provided by the SG-1000 main frame.

1-9. SPECIFICATIONS.

1-10. The electrical and physical characteristics of the Extender are listed in table 1-1.

Note

The Extender specifications listed in table 1-1 supplement and/or modify the specification only for that specific parameter of the SG-1000; other specifications of the SG-1000 are retained.

TABLE 1-1. SG-1001 SPECIFICATIONS

Parameter	Specification																																
Frequency Range, Resolution, Resettability and Accuracy (resettability = accuracy)	<table><tr><th>Tuning Band 1</th><th>Frequency Range</th><th>Resolution</th><th>Accuracy 2</th></tr><tr><td>7</td><td>3.9 - 8 MHz</td><td>100 Hz</td><td>0.0026 %</td></tr><tr><td>8</td><td>1.95 - 4 MHz</td><td>100 Hz</td><td>0.0051 %</td></tr><tr><td>9</td><td>0.98 - 2 MHz</td><td>100 Hz</td><td>0.01 %</td></tr><tr><td>10</td><td>490 - 1000 kHz</td><td>10 Hz</td><td>0.002 %</td></tr><tr><td>11</td><td>244 - 500 kHz</td><td>10 Hz</td><td>0.004 %</td></tr><tr><td>12</td><td>122 - 250 kHz</td><td>10 Hz</td><td>0.008 %</td></tr><tr><td>13</td><td>61 - 125 kHz</td><td>10 Hz</td><td>0.016 %</td></tr></table>	Tuning Band 1	Frequency Range	Resolution	Accuracy 2	7	3.9 - 8 MHz	100 Hz	0.0026 %	8	1.95 - 4 MHz	100 Hz	0.0051 %	9	0.98 - 2 MHz	100 Hz	0.01 %	10	490 - 1000 kHz	10 Hz	0.002 %	11	244 - 500 kHz	10 Hz	0.004 %	12	122 - 250 kHz	10 Hz	0.008 %	13	61 - 125 kHz	10 Hz	0.016 %
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7	3.9 - 8 MHz	100 Hz	0.0026 %																														
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11	244 - 500 kHz	10 Hz	0.004 %																														
12	122 - 250 kHz	10 Hz	0.008 %																														
13	61 - 125 kHz	10 Hz	0.016 %																														
Spurious Outputs:																																	
Harmonics	Greater than 45 dB below carrier.																																
Sub Harmonics	None																																
RF Output Level:																																	
Variation with frequency	RF output constant ± 0.2 dB.																																
Modulation:																																	
Internal AM distortion	Internal and external AM and FM.																																
External AM —																																	
Frequency	Less than 1.5% @ 30% AM; less than 3% @ 70% AM.																																
DC coupled	DC to 20 kHz for carriers above 2 MHz; DC to 15 kHz for carriers from 0.25 to 2 MHz; DC to 2 kHz for carriers up to 250 kHz. Response, flat ± 1 dB @ 30% AM within above carrier ranges.																																
AC coupled	Lower cutoff frequency below 20 Hz.																																
Range	(Curve below shows usable % AM as a function of modulating frequency).																																
Accuracy	0 to 70% , indicated on front panel meter $\pm 5\%$ of full scale.																																
Maximum usable % AM as a Function of Modulation Frequency (Typical)	TYPICAL MAXIMUM USABLE % AM AS A FUNCTION OF MODULATING FREQUENCY A — 61 to 250 kHz B — 25 to 2.0 MHz C — 2 to 8 MHz D — 8 to 512 MHz																																
External pulse	None																																
External video	None																																
Simultaneous modulation	Concurrent AM/FM.																																
GENERAL																																	
Operating power requirements	Taken from SG-1000																																
Power consumption	13 watts																																
Weight	5 pounds																																
Dimensions	4-15/16" H x 4" W x 12-1/2" D																																

- Notes: 1. SG-1000 provides bands 1 through 6.
2. ± 1 count.
3. Applies to SG-1000 only.

SECTION II OPERATION

2-1. GENERAL.

2-2. This section contains installation and operating instructions for the Extender. The Extender has been factory tested and aligned. When shipped with the SG-1000, it is in a ready-to-operate condition. If shipped separately, it requires calibration for the particular SG-1000 in which it will be installed. (See Section IV.) However, no attempt should be made to install or operate the unit until the operator is thoroughly familiar with the contents of this section.

2-3. INSTALLATION.

2-4. Inspect the Extender for indications of damage which may have occurred during shipment. Check the rotary switch on the front panel for positive detent action and freedom of movement.

2-5. To install the Extender in the SG-1000, remove the existing blank panel covering the plug-in cavity and insert the Extender. Be sure it is firmly seated in place. If resistance is noted in inserting the Extender, examine the guide pins and mating connectors for proper alignment. Tighten the knurled screw fastener on the Extender front panel to secure it to the SG-1000 frame.

Note

The SG-1001 must be calibrated to the SG-1000 with which it is used. Refer to paragraph 4-15.

2-6. OPERATION.

2-7. OPERATING CONTROL. The RANGE switch is the only operating control on the Extender. (See

figure 1-1.) It is a seven-position rotary switch which selects the desired (extended) frequency octave band of SG-1000 Signal Generator operation. The Extender RANGE switch functions only when the SG-1000 RANGE MHz switch is set to the PLUG-IN position (refer to SG-1000 operating controls). The Extender bands are:

3.9	-	8.0 MHz
1.95	-	4.0 MHz
.95	-	2.0 MHz
490	-	1000 kHz
244	-	500 kHz
122	-	250 kHz
61	-	125 kHz

2-8. OPERATING PROCEDURE. The Extender has no operating procedure of its own other than setting the RANGE switch to the desired frequency band during PLUG-IN operation of the SG-1000 Signal Generator.

Note

All SG-1000 operating procedures except video and pulse modulation may be performed in the extended frequency ranges.

2-9. PACKAGING INSTRUCTIONS.

2-10. Figure 2-1 illustrates the method of packing the Extender for long term storage or shipment. For short term storage, use a suitable protective covering, such as a polyethylene bag, and store the instrument in a clean, dry area. Store this instruction manual in the packing carton or bag to avoid loss.

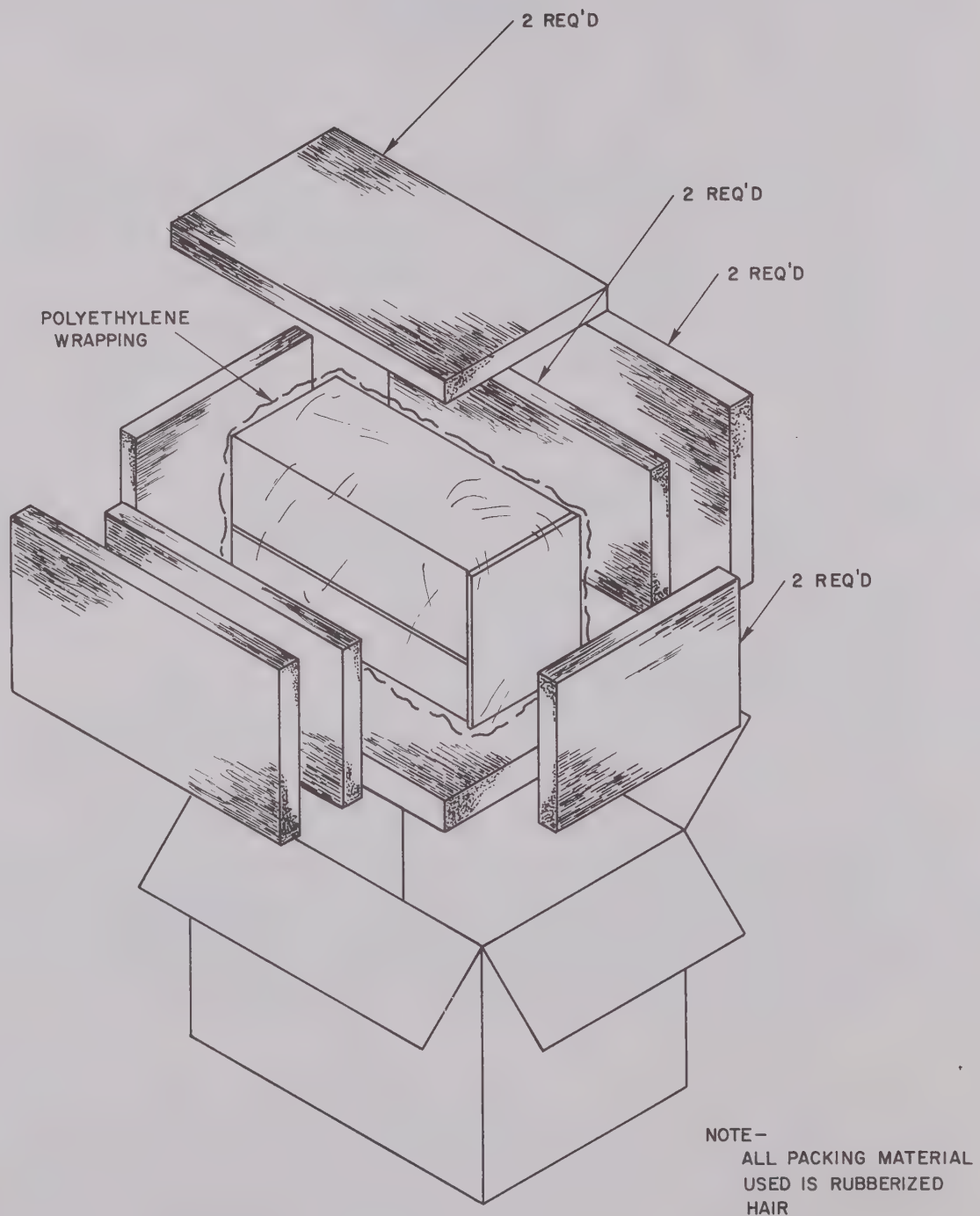


Figure 2-1. Packaging Diagram

SECTION III

THEORY OF OPERATION

3-1. SIMPLIFIED BLOCK DIAGRAM ANALYSIS. (See Figure 3-1.)

3-2. The Extender operates in conjunction with the Model SG-1000 Signal Generator. It extends the operating frequency capabilities of the SG-1000 from its lowest limit, 7.75 MHz, down to 61 kHz. Continuous frequency coverage is provided in seven overlapping octave RANGES. The lower frequencies are developed from an rf input of 7.75 to 16 MHz from the SG-1000 in a seven-stage divider chain, which develops sub-multiples ($f_o/2$, $f_o/4$, $f_o/8$, etc.) of the rf input frequency. This provides seven octave-wide tuning ranges which cover the range from 61 kHz to 8 MHz. The desired tuning band is selected by the Extender RANGE switch. Tuning within each RANGE is accomplished by setting the master oscillator in the SG-1000 to provide the required rf input frequency to the Extender in the range from 7.75 to 16 MHz. A band logic code, generated simultaneously with range selection, enables the SG-1000 frequency counter to readout the Extender frequency directly in kHz or MHz. Thus the same resettability and accuracy parameters and expanded resolution capability as the SG-1000 are provided for Extender frequencies.

3-3. The rf output of the frequency divider is coupled to an extremely linear balanced modulator followed by a wideband power amplifier. The power amplifier boosts the low level signal from the modulator and permits the Extender to furnish up to 100 milliwatts of rf power. Sharp cutoff low pass filters, selected by the RANGE switch, attenuate undesired harmonic outputs of the frequency dividers as well as any distortion produced in the power amplifier.

3-4. The output level of the Extender is maintained constant across the entire frequency range by means of a high-gain, closed loop feedback network. A sample of the rf output signal is detected and compared to a reference level set in by SG-1000 controls. The loop automatically maintains any selected level between +20 and +4 dBm. This correction loop maintains the level standards of the SG-1000. The detected rf signal is also applied to the SG-1000 where it is monitored on the RF level meter.

3-5. Frequency modulation of the rf output is accomplished in the SG-1000 master oscillator circuitry; the rf input contains frequency modulation at the input to the Extender. In this mode as in CW, the Extender performs a frequency conversion function and amplifies the rf signal. Amplitude modulation is accomplished at a low rf level with the balanced modulator. The modulating signal may be 1 kHz (optionally 400 Hz) or external modulation, both from the SG-1000. Modulation control and

monitoring is also accomplished in the SG-1000. Video and pulse modulation capabilities are not provided at the frequencies covered with the Extender.

3-6. FREQUENCY GENERATION CIRCUITS, DETAILED ANALYSIS. (See Figure 3-2.)

3-7. FREQUENCY DIVIDERS. When the SG-1000 RANGE MHz switch is set to PLUG-IN, a +4.2 VDC plug-in enable signal is applied to the Extender. This enables gate transistor A1Q1, couples the 7.75 to 16 MHz rf input from the SG-1000 to the first of a seven-stage binary frequency divider chain. (See figures 5-2 and 5-3.) Integrated circuit binary dividers A2MC1, MC2, and MC3 are high frequency IC's which produce relatively clean, square wave signals at $f/2$, $f/4$, and $f/8$ at their respective outputs. IC's A2MC4 and MC5 are similar binary dividers except that each has two divider sections and they operate at lower frequencies. A2MC4 produces square wave outputs of $f/16$ and $f/32$; A2MC5 produces outputs of $f/64$ and $f/128$. The output of each frequency divider, typically at 1 volt p-p, is coupled to wafer A of RANGE switch A2S1, which selects the desired frequency RANGE. Buffer Q1 provides the necessary drive level for the balanced modulator and presents a constant impedance to the frequency divider.

3-8. To prevent interference due to sub-harmonics generated by the divider chain, all dividers following the selected output are inhibited. This is accomplished by wafer B of RANGE switch A2S1, which applies an inhibit signal to the divider following the selected output. In band 7 (4-8 MHz), a ground inhibit is applied to band 8 divider A2MC2, disabling it and all subsequent divider operations. In band 8, the ground inhibits band 9 divider A2MC3. Bands 10 through 12 are similarly inhibited, except that a positive inhibit signal is required for these IC types. Inverters in integrated circuit A2MC6 provide the necessary inversion. The entire divider chain is utilized to produce the 61 to 125 kHz output in band 13, therefore none of the dividers are inhibited.

3-9. RANGE TIME CONSTANT CODING AND COUNTER CODING FUNCTIONS. The range selected by the Extender is indicated by the logic level present at the output of the A2MC6 inverters. This data is used to control selection of one of three time constants in the level detector and modulation circuits (paragraph 3-16). Data is encoded to produce a three-bit logic output. Thus the shortest time constant is selected for bands 7 and 8, a longer time constant for bands 9, 10, and 11, and the longest for bands 12 and 13. Encoding is accomplished in OR gates A1CR3 through A1CR7 and NOR gate A1MC1. (See

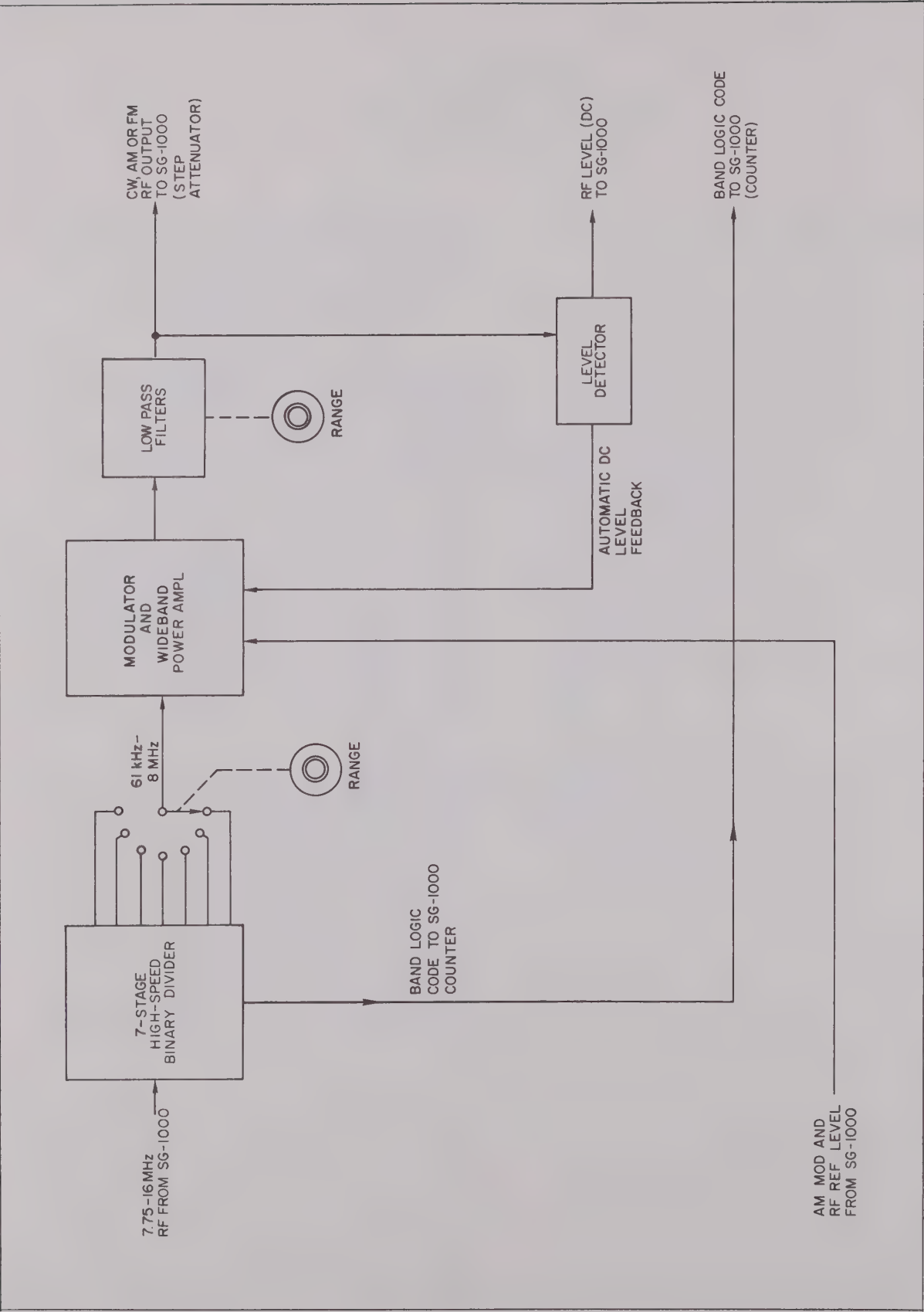


Figure 3-1. SG-1001 Simplified Block Diagram

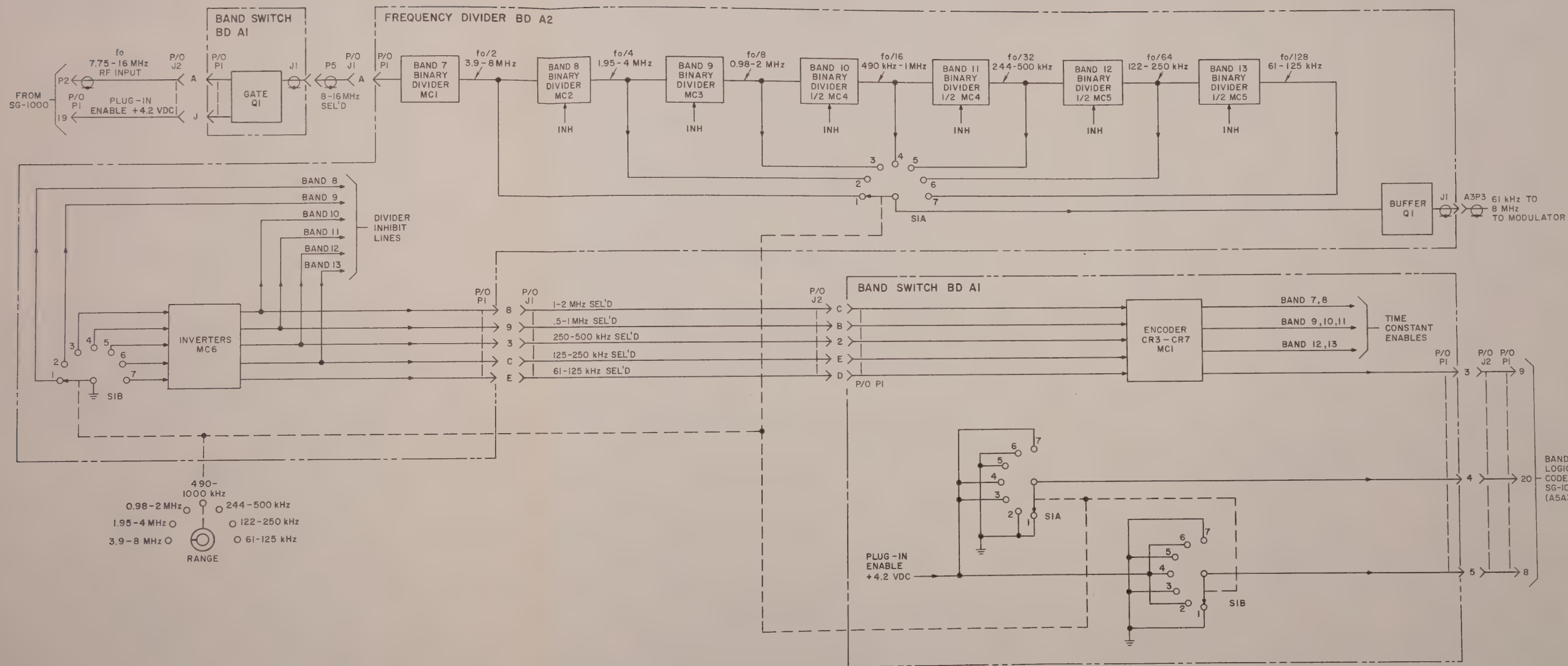


Figure 3-2. Frequency Generation Block Diagram

figure 5-2.) The encoder also provides one bit of a three-bit RANGE-logic code that is supplied to the SG-1000 frequency counter circuitry. The other two bit levels are established directly by the position of

RANGE switch A1S1; the terminals of wafers A and B are connected to ground or +4.2 VDC to provide the required logic level. The three-bit code supplied by the Extender for each range is listed in table 3-1.

TABLE 3-1. SG-1001 BAND LOGIC CODE

SG-1001 RANGE Switch Setting	Band	Code		
		P1-3	P1-4	P1-5
3.9 - 8.0 MHz	7	L	L	L
1.95 - 4.0 MHz	8	L	L	H
.95 - 2.0 MHz	9	L	H	L
490 - 1000 kHz	10	L	H	H
244 - 500 kHz	11	H	L	L
122 - 250 kHz	12	H	L	H
61 - 125 kHz	13	H	H	L

Note: H ("high") level is +0.8 volt or greater
L ("low") level is +0.43 volt or less (ground)

3-10. Within the SG-1000 frequency counter, the Extender band logic code is utilized to control a four-bit BCD logic code, which in turn establishes a 19-bit logic output that controls gating functions in the counter. By controlling the gating intervals, the extended frequencies are indicated directly in kHz or MHz on the display, with resolution equal to that obtained for SG-1000 frequencies. Refer to the SG-1000 manual for a complete description of the frequency counter and the logic and gating circuitry employed during Extender (plug-in) operation. Supplemental data relative to the operation of the frequency counter in the

Extender ranges is furnished in tables 3-2 through 3-6 as follows:

- Table 3-2. Band Selector Code Output SG-1001 Supplement
- Table 3-3. Decoder Input/Output Characteristics SG-1001 Supplement
- Table 3-4. Count Frequencies SG-1001 Supplement
- Table 3-5. Δt Gate Generation Data SG-1001 Supplement
- Table 3-6. Decimal Point Positioning Data SG-1001 Supplement

TABLE 3-2. BAND SELECTOR CODE OUTPUT SG-1001 SUPPLEMENT

SG-1001 RANGE Switch Setting	Code Line			
	A	B	C	D
3.9 - 8.0 MHz	H	H	H	L
1.95 - 4.0 MHz	L	H	H	L
.95 - 2.0 MHz	H	L	H	L
490 - 1000 kHz	L	L	H	L
244 - 500 kHz	H	H	L	L
122 - 250 kHz	L	H	L	L
61 - 125 kHz	H	L	L	L

Note: H ("high") level is +0.8 volt or greater
L ("low") level is +0.4 volt or less

TABLE 3-3. DECODER INPUT/OUTPUT CHARACTERISTICS, SG-1001 SUPPLEMENT

SG-1001 RANGE Switch Setting	Inputs										Outputs														
	A	B	C	D	1	2	3	4	5	6	P	7	8	9	10	11	12	13	W	X	Y	Z	S		
3.9 - 8.0 MHz	H	H	H	L	H	H	H	H	H	H	L	L	H	H	H	H	H	H	H	H	L	H	H		
1.95 - 4.0 MHz	L	H	H	L	H	H	H	H	H	H	L	H	L	H	H	H	H	H	H	H	L	H	H		
.95 - 2.0 MHz	H	L	H	L	H	H	H	H	H	H	L	H	H	L	H	H	H	H	H	H	L	H	H		
490 - 1000 kHz	L	L	H	L	H	H	H	H	H	H	L	H	H	H	L	H	H	H	H	H	L	H			
244 - 500 kHz	H	H	L	L	H	H	H	H	H	H	L	H	H	H	H	L	H	H	H	H	L	H			
122 - 250 kHz	L	H	L	L	H	H	H	H	H	H	L	H	H	H	H	L	H	H	H	H	L	H			
61 - 125 kHz	H	L	L	L	H	H	H	H	H	H	L	H	H	H	H	H	L	H	H	H	L	H			

Note: H ("high") level is +0.8 volt or greater.
L ("low") level is between 0 and +0.4 volt.

TABLE 3-4. COUNT FREQUENCIES, SG-1001 SUPPLEMENT

SG-1001 RANGE Switch Setting	f_c
3.9 - 8.0 MHz	$f/32$ (242.187 - 500 kHz)
1.95 - 4.0 MHz	$f/32$ (242.187 - 500 kHz)
.95 - 2.0 MHz	$f/32$ (242.187 - 500 kHz)
490 - 1000 kHz	$f/32$ (242.187 - 500 kHz)
244 - 500 kHz	$f/32$ (242.187 - 500 kHz)
122 - 250 kHz	$f/32$ (242.187 - 500 kHz)
61 - 125 kHz	$f/32$ (242.187 - 500 kHz)

TABLE 3-5. Δt GATE GENERATION DATA, SG-1001 SUPPLEMENT

SG-1001 RANGE Switch Setting	Normal Count					Expanded (X100) Resolution Count						
	A8A3A1 MC17-8	A8A3A1 MC1-6	A8A3A3 MC10-6	Δt	Sampling Rate	Display Time per Sample	A8A3A1 MC17-8	A8A3A1 MC1-6	A8A3A3 MC10-6	Δt	Sampling Rate	Display Time per Sample
3.9 - 8.0 MHz	4MHz	62.5 kHz	1.25 kHz	1.6 msec	78.2/sec	10.4 msec	40 kHz	625 Hz	12.5 Hz	160 msec	1.56/sec	400 msec
1.95 - 4.0 MHz	4 MHz	125 kHz	2.5 kHz	0.8 msec	156.3/sec	5.2 msec	40 kHz	1.25 kHz	25 Hz	80 msec	3.125/sec	200 msec
.95 - 2.0 MHz	4 MHz	250 kHz	5 kHz	0.4 msec	312.5/sec	2.6 msec	40 kHz	2.5 kHz	50 Hz	40 msec	6.25/sec	100 msec
490 - 1000 kHz	4 MHz	500 kHz	1 kHz	2 msec	62.5/sec	13 msec	40 kHz	5 kHz	10 Hz	200 msec	2.5/sec	100 msec
244 - 500 kHz	4 MHz	1 MHz	2 kHz	1 msec	125/sec	6.5 msec	40 kHz	10 kHz	20 Hz	100 msec	2.5/sec	250 msec
122 - 250 kHz	4 MHz	2 MHz	4 kHz	0.5 msec	250/sec	3.25 msec	40 kHz	20 kHz	40 Hz	50 msec	5/sec	125 msec
61 - 125 kHz	4 MHz	4 MHz	8 kHz	0.25 msec	500/sec	1.625 msec	40 kHz	40 kHz	80 Hz	25 msec	10/sec	62.5 msec

TABLE 3-6. DECIMAL POINT POSITIONING DATA, SG-1001 SUPPLEMENT

SG-1001 RANGE Switch Setting	Counter Readout	
	Normal Count	Expanded Resolution Count
3.9 - 8.0 MHz	X3.87 MHz to X8.00 MHz	.X750 MHz to .X000 MHz
1.95 - 4.0 MHz	X1.93 MHz to X4.00 MHz	.X375 MHz to .X000 MHz
.95 - 2.0 MHz	X0.96 MHz to X2.00 MHz	.X687 MHz to .X000 MHz
490 - 1000 kHz	X484. kHz to 1000. kHz	X4.37 kHz to X0.00 kHz
244 - 500 kHz	X242. kHz to X500. kHz	X2.18 kHz to X0.00 kHz
122 - 250 kHz	X121. kHz to X250. kHz	X1.09 kHz to X0.00 kHz
61 - 125 kHz	X060. kHz to X125. kHz	X0.54 kHz to X5.00 kHz

Note: X signifies blank (no indication)

3-11. MODULATION AND POWER AMPLIFIER CIRCUITS, DETAILED ANALYSIS. (See Figure 3-3.)

3-12. CW OPERATION. Balanced modulator A3MC1 receives two inputs, a dc reference level at its modulation input, and the selected 61 kHz to 8 MHz carrier from the frequency divider. The reference level, which is applied to pin 1 of A3MC1 (figure 5-4), sets the quiescent operating point of the balanced modulator. The selected carrier is coupled through the modulator to the amplifier chain from pin 6. Capacitor C8 and resistor R19 are connected to the other modulator output, pin 9, for balance. Potentiometer A3R10 adjusts the outputs for balance. The amplifier, driver, and power amplifier chain A3Q2 through Q6 have a total gain of approximately 48 dB from below 61 kHz to above 8 MHz.

3-13. The output of the power amplifier, which is rich in harmonic content because of the signals handled, is applied to the low pass filter circuits which attenuate unwanted carrier harmonics. The low pass filter circuits contain one high-end and one low-end LC filter network associated with each of the Extender frequency ranges. There are a total of 14 filters connected in various P1 configurations with selected values. (See figures 5-6 and 5-7.) The high-end filters have a passband that extends to the upper limit of each band, and has an extremely sharp skirt at its upper limit to attenuate unwanted harmonics outside the band. The low-end filters are similar except that the pass band upper limit extends to the center of the selected frequency range. A sharp upper limit skirt attenuates unwanted harmonics above the center.

3-14. The appropriate filter pair for the band is selected by the RANGE switch. A band center command is generated by the SG-1000 frequency counter, and applied to high-low filter switches A1Q2 through Q4 (figure 5-2). The band center command is +6 volts when the master oscillator in the SG-1000 is

tuned above its geometric mean. Switches A1Q2 through Q4 generate a high-end enable, which energizes high-end relays A4A2K1 and K2, connecting the high end filter into the signal path. Below the geometric mean the band center command is 0 volt, and the low end relays are connected into the signal path by the energization of low end relays A4A3K1 and K2. The filtered rf output is coupled through the SG-1000 low pass filter assembly to the step attenuator circuits of the SG-1000 where calibrated attenuation may be inserted in the signal path.

3-15. The output level of the Extender is maintained constant across its entire frequency range by means of a high-gain closed loop feedback network consisting of buffer driver A3Q7 and Q8, level detector CR4, and leveling amplifier A3MC2. (See figure 5-4.) A sample of the rf output is rectified by level detector A3CR4. Resistors A3R43, R46, and L1 provide bias for A3CR4. The detector output, a negative voltage, is applied to the summing point of leveling amplifier A3MC2, an operational amplifier. The desired reference level, adjustable between 0 and +3 volts, is set in to the summing point by the dBm 50Ω control in the SG-1000. The two signals are continuously compared and the difference amplified to drive modulation divider networks A3R5 and R6. This high gain correction loop automatically adjusts the operating point of balanced modulator A3MC1 so that the rf level at the detector (and the Extender output) is maintained essentially constant at any selected level from 0 to -16 dB on the RF LEVEL meter.

3-16. In order to maintain the rf output constant on all RANGES, three time constant networks are used in the level detector. The networks consist of A3R36 and R37, which are common loads, and capacitors C20, C21, and C22, which are switched in on the different ranges. These change the bandwidth in the detector, and thus maintain a constant detector signal output. The required capacitor is switched in-circuit by an enable signal that originate in the range coding circuits (paragraph 3-9).

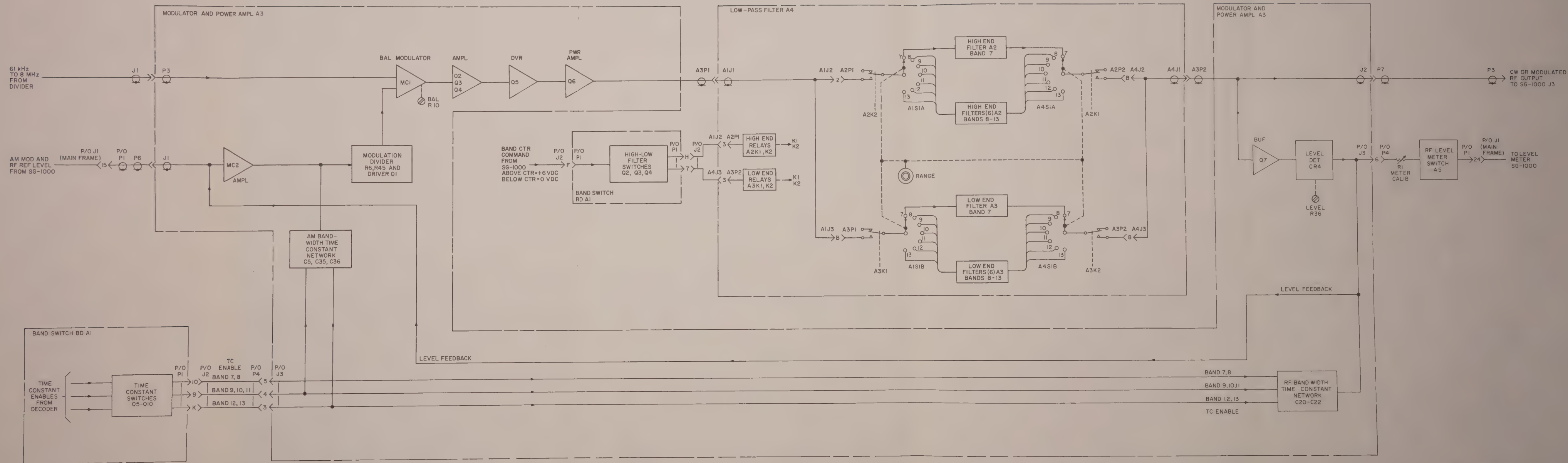


Figure 3-3. Modulation and Power Amplifier Block Diagram

The enable signal turns on the appropriate switches, A1Q5 through Q10 at the selected range. (See figure 5-2.) With the switches turned on, a positive dc voltage forward biases diodes associated with time constant capacitor C20, C21, or C22, electrically placing the capacitor in-circuit.

3-17. The dc level produced by the level detector is also applied through meter calibrator potentiometer R1 to rf level meter switch A5. The switch prevents interaction between the SG-1000 and the Extender rf level circuits in other than Extender ranges. The switch is closed only when the SG-1000 RANGE MHz is set to PLUG-IN. The switch consists of transistor A5Q1 and FET A5Q2. (See figure 5-9.) In the PLUG-IN, +4.2 VDC turn on A5Q1. This turns on FET A5Q2 providing a low impedance between its source and drain terminals. The Extender level detector output is applied through FET A5Q2 to the SG-1000 rf level meter where it is monitored.

3-18. FM OPERATION. Frequency modulation of the carrier is accomplished at the master oscillator in the SG-1000. The rf input to the Extender already contains FM. The FM carrier is processed in the same manner as CW.

3-19. AM OPERATION. For amplitude modulation, the modulating signal from the SG-1000 (either internal 1 kHz, optionally 400 Hz, or external modulating frequencies) is super-imposed on the dc level control reference input. The modulating signal is amplified by A3MC2 and driver A3Q1 and fed to modulation divider A3R6 and R45. (See figure 5-4.) Amplitude modulation is achieved by varying the signal amplitude at the input to the balanced modulator. As in the SG-1000 frequency ranges, the maximum unmodulated rf power output level during AM is +14 dBm, permitting modulation percentages up to 100% to be attained at the full rated output power (+20 dBm).

3-20. To attain optimum bandwidth and maintain gain and loop stability on all bands during amplitude modulation, three time constant networks at the output of leveling amplifier A3MC2 are selected, depending upon the range. The networks consist of series connected A3R57 and A3C56, which are always in-circuit, and A3C5 and A3C35 which are switched in. (See figure 5-4.) Capacitors A3C5 and A3C35 are placed in-circuit in bands 9, 10, 11 and 12, 13 respectively by time constant switches A1Q5 through A1Q10, which forward bias the associated diodes.

SECTION IV MAINTENANCE

4-1. GENERAL.

4-2. This section contains maintenance instructions for the Extender. No attempt should be made to repair internal components or make adjustments until the operator is thoroughly familiar with the information contained in this section.

4-3. The performance of the Extender may be checked using the minimum performance standards checks provided to determine whether the equipment is operating within published specifications. A systematic troubleshooting procedure to isolate troubles

in the Extender and an alignment procedure to restore the equipment to proper operating condition after the required repairs have been effected are also included in this section.

4-4. TEST EQUIPMENT REQUIRED.

4-5. The test equipment required for the maintenance and alignment of the Extender is listed in table 4-1. Equipment having similar characteristics may be substituted for those listed in the table.

TABLE 4-1. TEST EQUIPMENT REQUIRED

Equipment	Manufacturer and Model
Frequency Counter	Hewlett-Packard Model 5245L
Signal Generator	Hewlett-Packard Model 651A
Differential Voltmeter	Keithly Model 600
Single Sideband Spectrum Analyzer	Singer Model SSB-50
RF Voltmeter	Boonton Model 91-C (with H1-Z probe)
Oscilloscope	Tektronix Model 545 (with 1 x 1 and 10 x 1 probes)
Digital Voltmeter	Digitee Model 20V
Thermo Couple	5 ma at .5 VRMS <i>* output is 2.2V at +20 dB</i>
20 dB pad ± 1 dB	Any commercially acceptable - Flat between 60 kHz and 8 MHz <i>can use 3V unit. AGP</i>
50 Ohm Load	Any commercially acceptable

4-6. PERFORMANCE STANDARDS.

4-7. The performance standards checks listed in table 4-2 provide a rapid means of evaluating Extender performance. These checks are performed with the Extender installed and operating with the SG-1000. The SG-1000/SG-1001 system should be turned on and permitted to stabilize for 30 minutes. The qual-

ity of these checks pre-suppose that the SG-1000 is operating within acceptable limits.

4-8. COMPONENT LOCATIONS.

4-9. The locations of printed circuit boards and all components of the Extender are illustrated in figures 4-2 through 4-9.

TABLE 4-2. PERFORMANCE STANDARDS CHECKS

Step	Purpose	Procedure	Acceptable Indication
1	To check frequency range	Note Set the SG-1000 RANGE MHz to PLUG-IN for all Extender checks. - Connect the SG-1000/SG-1001 in the test setup of A, figure 4-1. - Set the RANGE switch to the positions listed below and tune throughout each range. Compare the readouts on the SG-1000 and external frequency counters. 3.9 - 8 MHz (Band 7) 1.95 - 4 MHz (Band 8) .98 - 2 MHz (Band 9) 490 - 1000 kHz (Band 10) 244 - 500 kHz (Band 11) 122 - 250 kHz (Band 12) 61 - 125 kHz (Band 13)	Minimum frequency coverage for each band shall be as indicated by the RANGE switch position.
2	To check for harmonic distortion	- Connect the SG-1000/SG-1001 in the test setup of B, figure 4-1. - Adjust the SG-1000 controls for a +20 dBm output at 61 kHz. - Tune through the entire band from 61 kHz through 8 MHz while tracking the second harmonic with the single side band spectrum analyzer. Measure the second harmonic level. - Repeat step c while tracking the third harmonic with the spectrum analyzer.	Second and third order harmonics shall be >45 dB below the carrier on all ranges.
3	To check the rf output level variation with frequency (flatness)	- Connect the SG-1000/SG-1001 in the test setup of C, figure 4-1. - Set the SG-1000 dBm, 50Ω switch to 0 dBm and the level control to full scale (0).	The rf output shall remain constant ± 0.2 dB throughout the entire frequency range.

(Cont'd)

TABLE 4-2. PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
		c. Set the DVM controls as follows: Voltage switches to 0.00177v Polarity switch to - (negative) Range switch to 0.5 Null switch to 10 mv d. The DVM should read approximately 0. e. Set SG-1000/SG-1001 to 8 MHz, DVM null switch 0.1 mv, and DVM meter zero control for +40 indication. This setting is the reference for tests. f. Tune through the 3.9 - 8 MHz band noting the greatest variation ($\pm$) from the reference set in step e. g. Repeat step f on bands 8 - 13 (61 kHz - 4 MHz) noting the greatest variation from the reference, established in step e. h. Compute variation as follows: 1. Divide the greatest variation noted in step g by 2. 2. Divide the quotient of 1 by 1.77 to find ratio. 3. Multiply ratio by 10 to find variation in dB. Example: 1. $\frac{\text{Greatest variation, step g}}{2} = X$ 2. $\frac{X}{1.77} = \text{Ratio}$ 3. 10 Ratio = Variation in dB	

(Cont'd)

TABLE 4-2. PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
4	To check the AM modulation accuracy.	a. Connect the SG-1000/SG-1001 in the test set up of E, figure 4-1. b. Set HP-651A to 1 kHz and for 100% modulation as monitored on Tektronix 545 Oscilloscope. Percent modulation meter should indicate 100% ± 5 .	Modulation accuracy shall be $\pm 50\%$ of full scale.

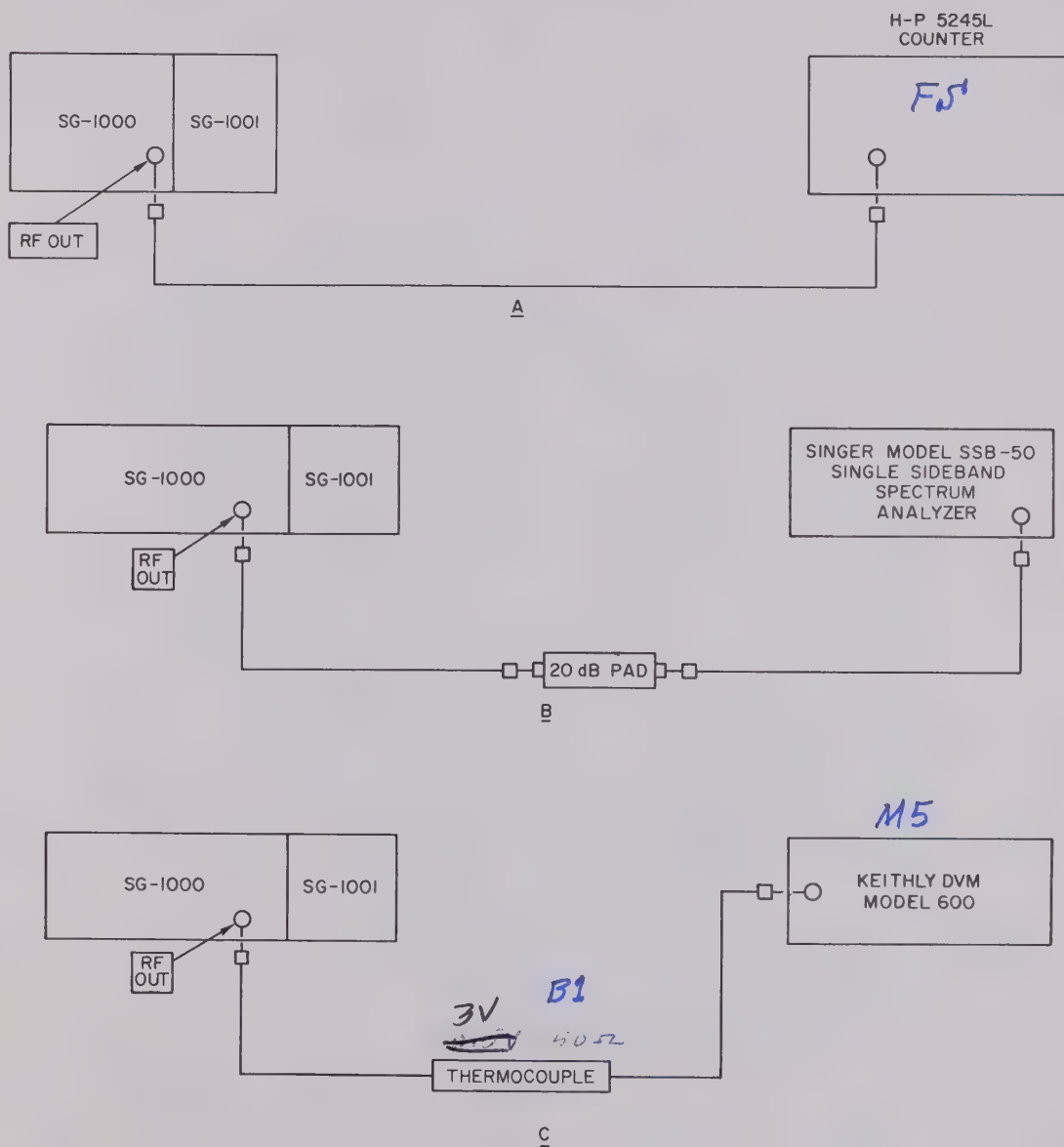


Figure 4-1. Performance Verification Test Setup (Sheet 1 of 2)

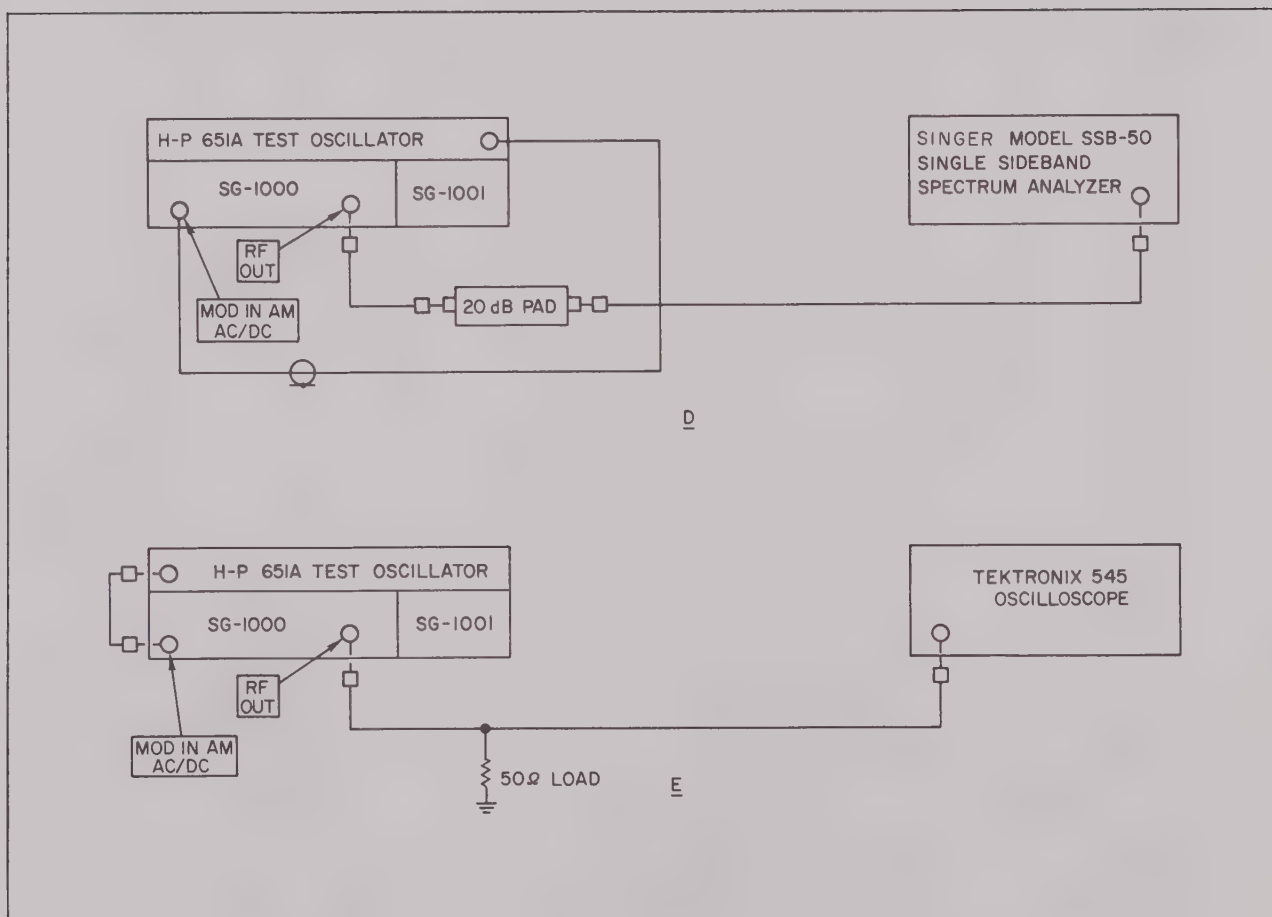


Figure 4-1. Performance Verification Test Setup (Sheet 2 of 2)

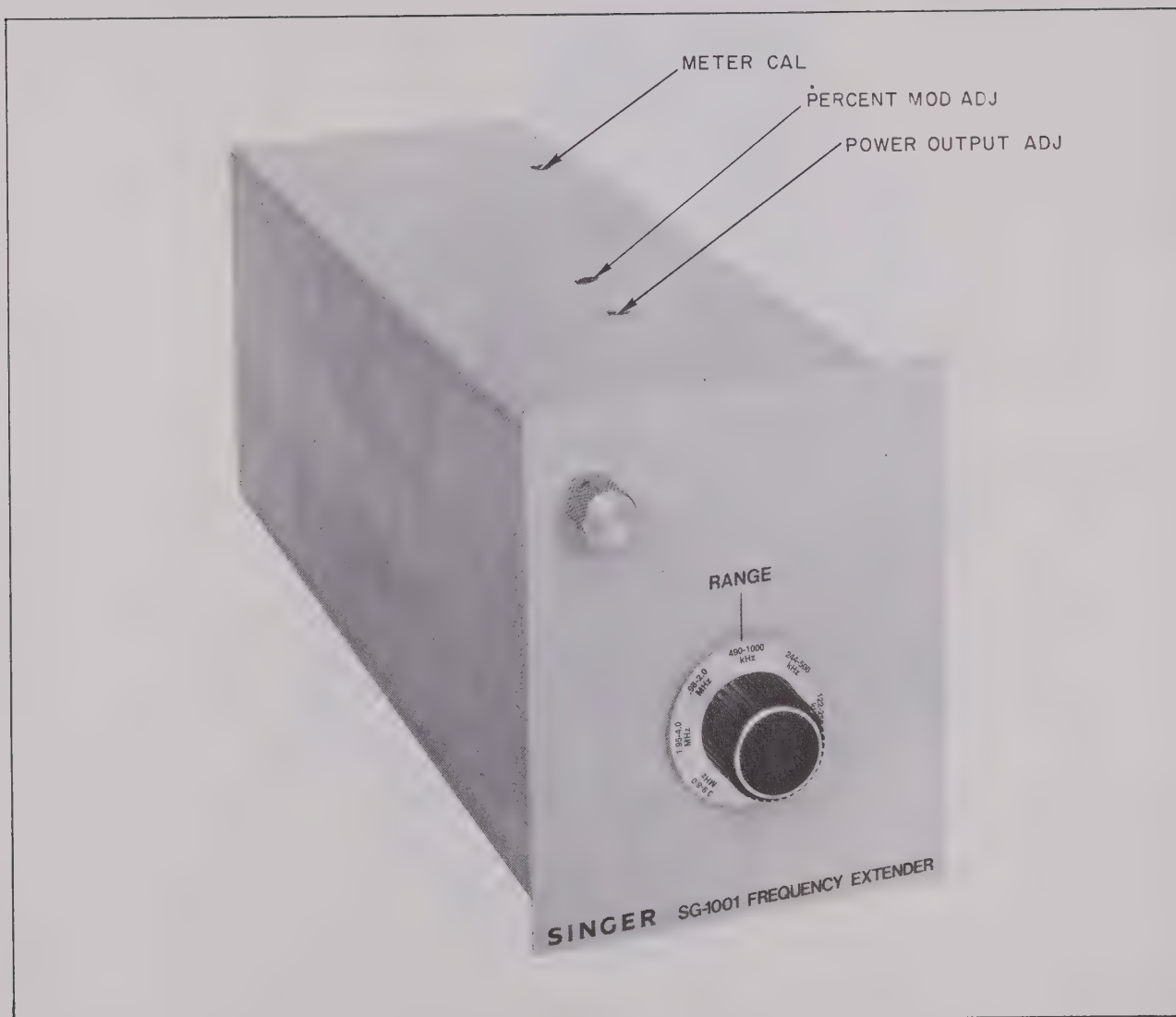


Figure 4-2. Adjustment Locations

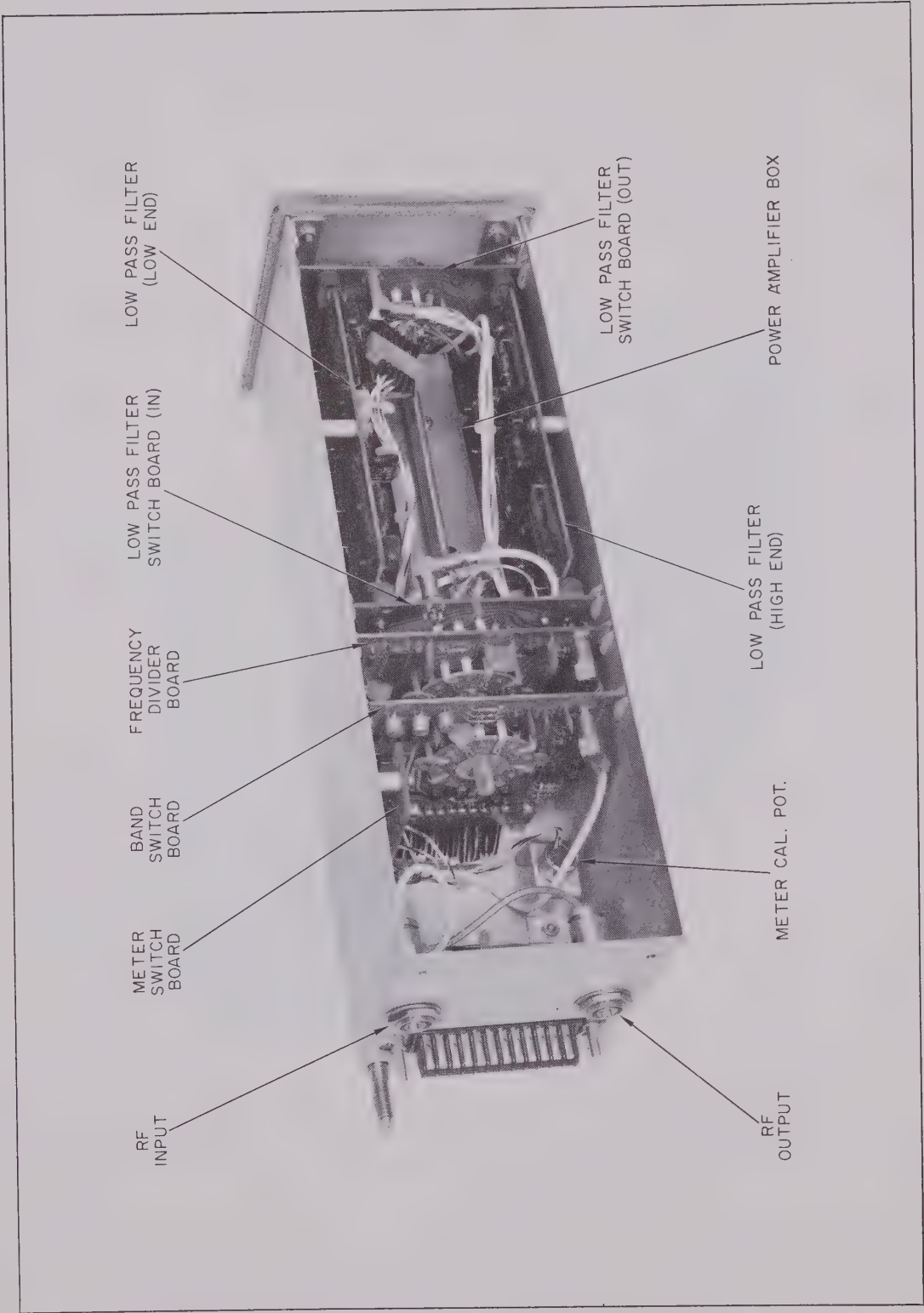


Figure 4-3. Subassembly Locations

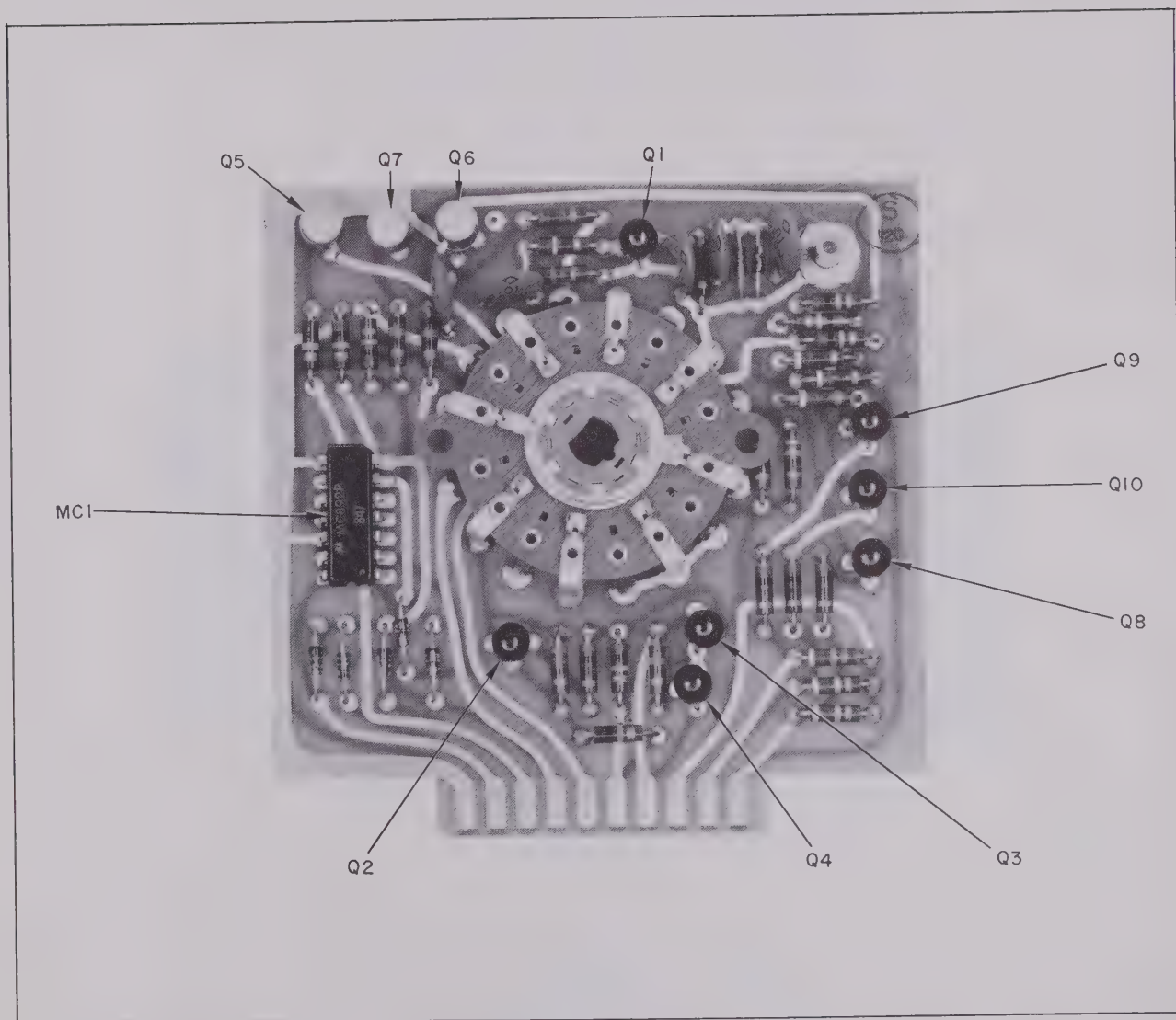


Figure 4-4. Band Switch Board A1

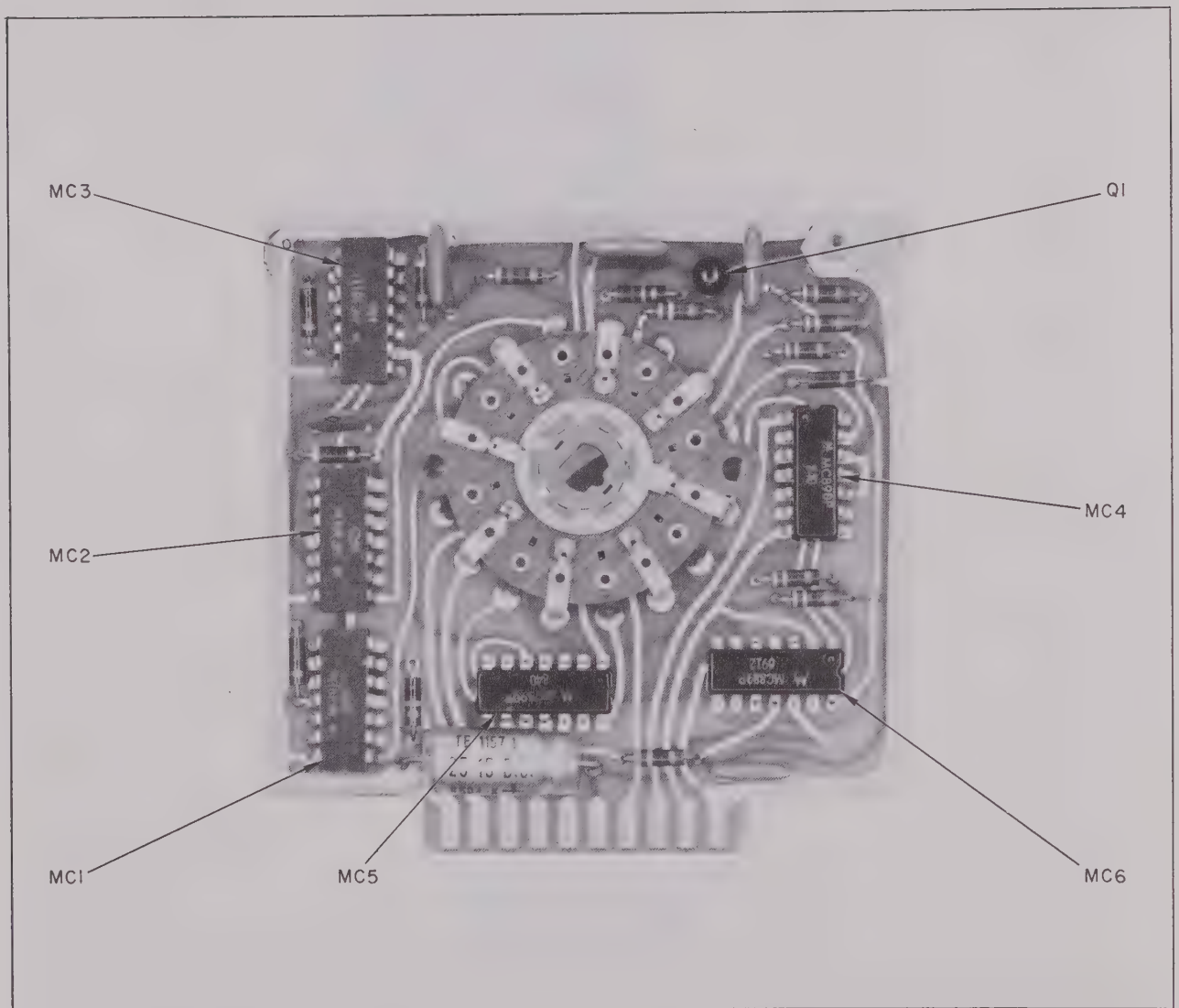


Figure 4-5. Frequency Divider Board A2

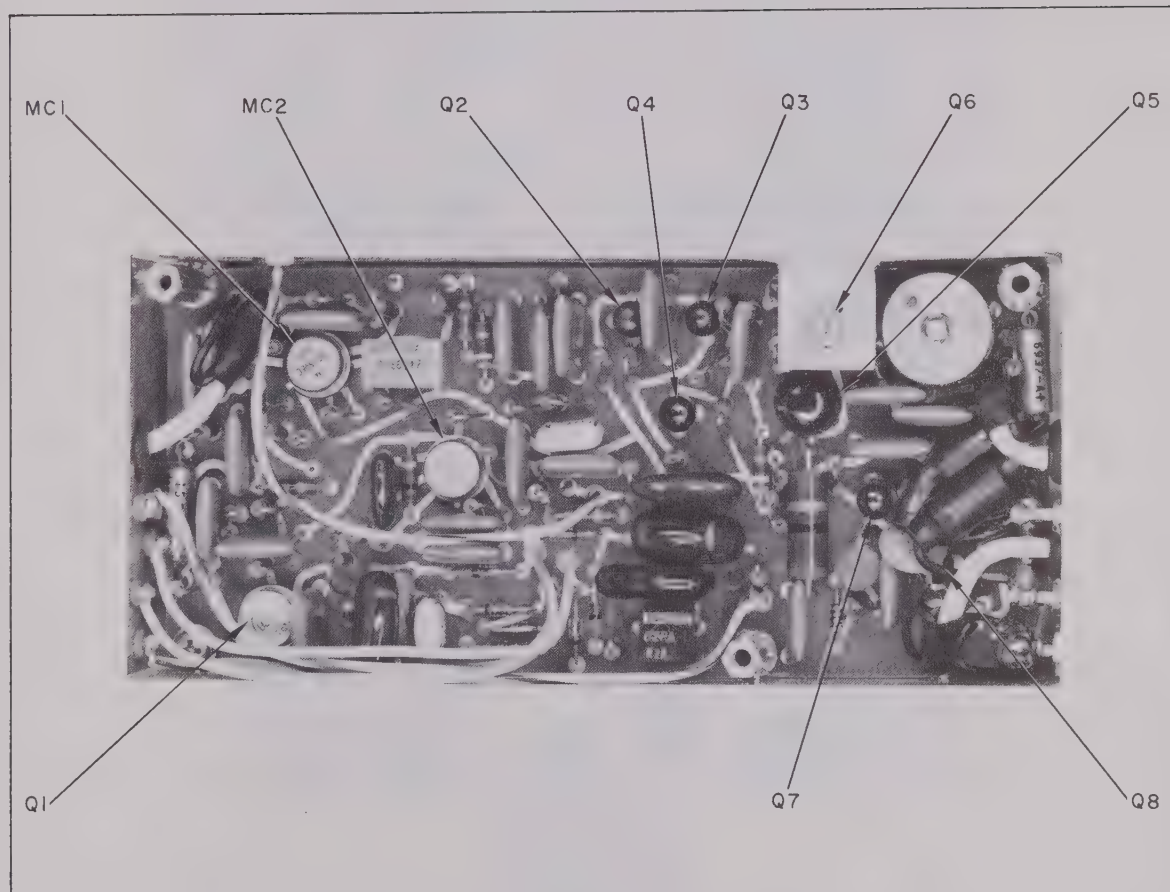


Figure 4-6. Power Amplifier Board A3

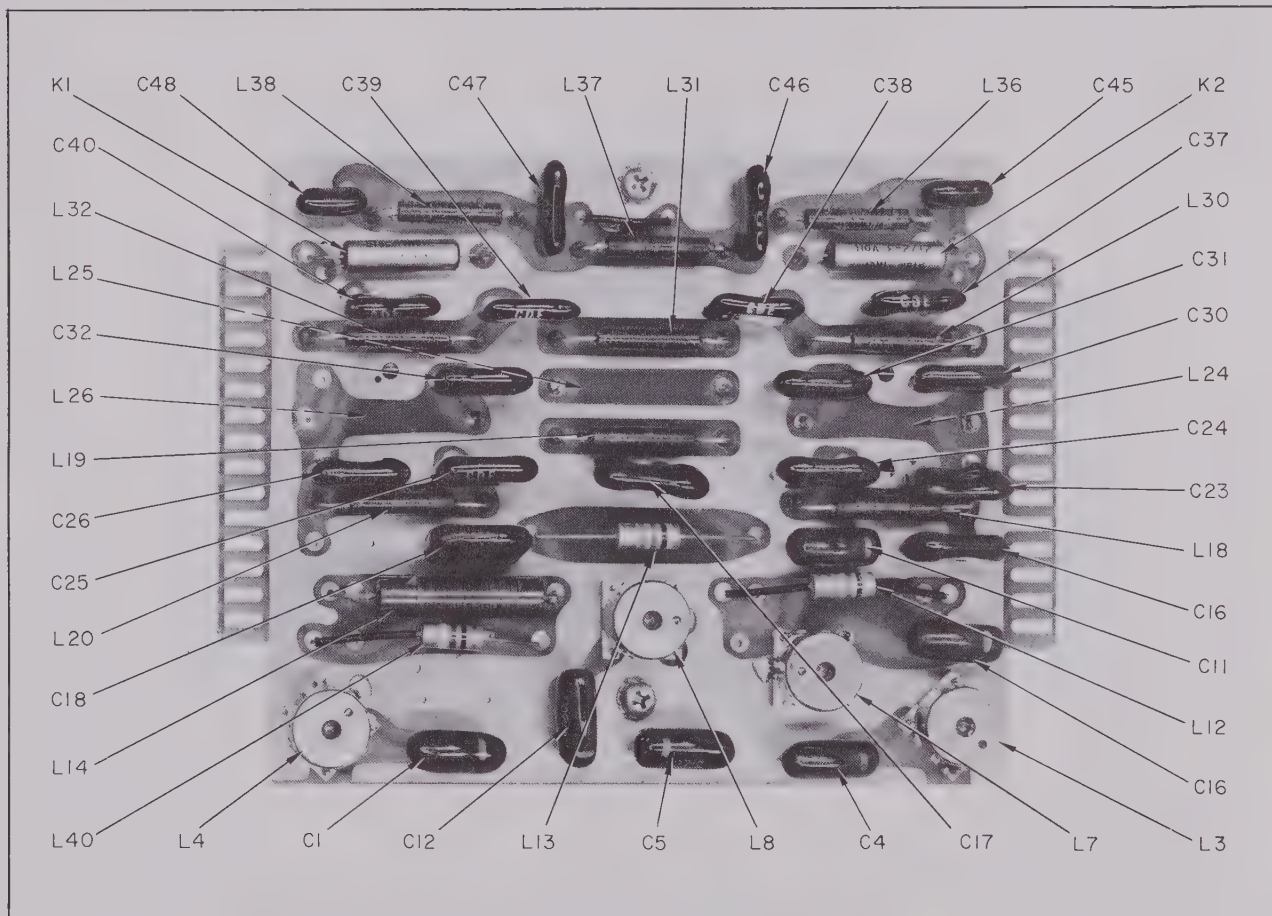


Figure 4-7. Low Pass Filter Board (High End) A4A2

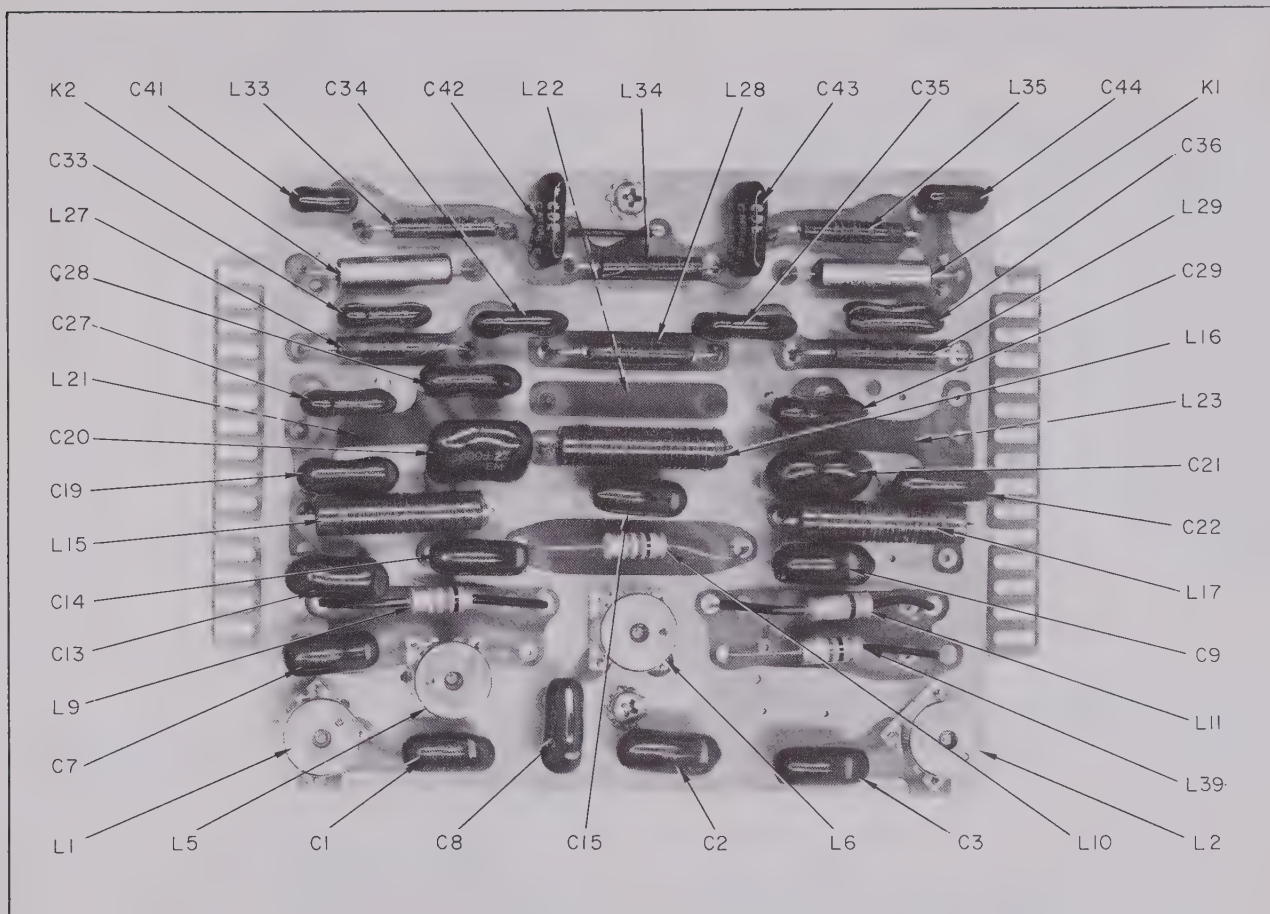


Figure 4-8. Low Pass Filter Board (Low End) A4A3

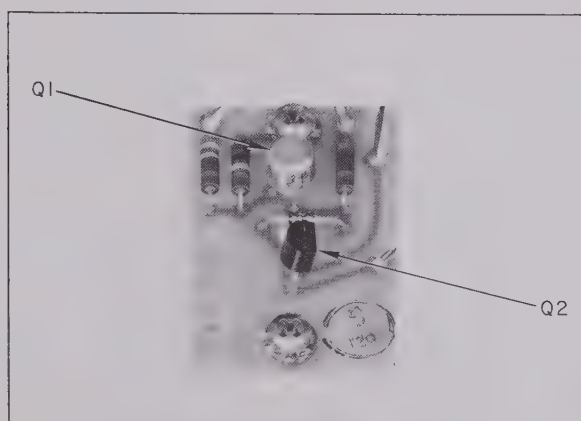


Figure 4-9. Meter Switch Board A5

4-10. TROUBLE LOCALIZATION.

4-11. Troubles within the Extender are generally localized from the nature of the trouble symptom or from the performance verification that was failed. Frequently, further localization can be made by manipulating the SG-1000 controls and observing the response. Signal tracing or substitution can often help localize the malfunction quickly. A thorough understanding of the Extender operation provided in Section III is essential in any trouble analysis approach. Once the malfunction is localized to a section or circuit, defective parts may be located through voltage measurements provided in paragraph 4-18. Troubleshooting is performed with the Extender chassis removed from its case and interconnected with the SG-1000 using the extender cables and harness. A symptomatic trouble localization guide is provided in table 4-3 as an aid in trouble localization. This table lists the probable cause of trouble for each symptom.

4-12. TEST AND ADJUSTMENT.

4-13. TEST EQUIPMENT REQUIRED. The test equipment required to check the low pass filter A4 is listed below. Equivalents may be substituted.

- a. Signal Generator H-P 606
- b. RF Voltmeter, Boonton 91-C (with H1-Z probe)
- c. Resistive matching network consisting of two 51-ohm and two 68-ohm resistors (See figure 4-4.)
- d. 1/4" shift (for changing bands)
- e. 6 Volt Power Supply (any type)

4-14. TEST AND ADJUSTMENT PROCEDURE. Paragraphs 4-14a thru 4-14k contain adjustments for low pass filter A4. Paragraphs 4-14l thru 4-14p contain the balance adjustment for the balanced modulator.

- a. Disconnect input and output coaxial connectors from A1J1 and A4J1 on the low pass filter.
- b. Connect resistive matching networks to the H-P 606 signal generator and Boonton 91-C rf voltmeter as shown in figure 4-10.
- c. Connect the +6 volt supply to A1J2-3 for high-end filter testing.
- d. Disconnect points 1 and 2 (figure 4-10) from the low pass filter and short together to set up a reference point on 1 volt range.
- e. Adjust the H-P 606 signal generator for a convenient reference level.
- f. Set the RANGE switch to 3.9 - 8 MHz (Band 7) and re-connect points 1 and 2 to the low pass filter jacks A1J1 and A4J1 respectively.
- g. Tune the H-P 606 through the pass band for the high-end filter as noted in table 4-4. Note that the response on the rf voltmeter should be down -2 dB at the cut-off frequency, the upper limit of the pass band, and be flat within 2 dB to the lower limit. If the proper response is not obtained, the high end filter coils, L36, L37, and L38 must be adjusted for the proper response.

TABLE 4-3. TROUBLE LOCALIZATION

Symptom	Probable Cause
RF LEVEL meter does not indicate rf measured at RF OUT jack.	Rf level switch board A5 defective.
No leveling on any frequency band.	Power amplifier board A3 (detector) defective.
No rf output on a specific band.	Low pass filter A4 defective.
No output on 61 - 122 kHz range (band 13).	Frequency divider board A2 defective.
Incorrect frequency indicated on frequency counter on Extender ranges.	Band switching board A1 (BCD code) defective.
No rf output at lower half or higher half of all bands.	Band switching board A1 defective; low pass filter A4 defective.

TABLE 4-4. LOW PASS FILTER TEST DATA

RANGE	LOW END FILTER						HIGH END FILTER					
	Pass Band*	SECOND HARMONIC		THIRD HARMONIC		Pass Band*	SECOND HARMONIC		THIRD HARMONIC			
		Freq.	Atten. (dB)	Freq.	Atten. (dB)		Freq.	Atten. (dB)	Freq.	Atten. (dB)		
4 - 8 MHz	3.9 - 5.6 MHz	7.8	-30	11.7	-55	5.6 - 8.0 MHz	11.2	-30	16.8	-55		
2 - 4 MHz	1.95 - 2.8 MHz	3.9	-30	5.85	-55	2.8 - 4.0 MHz	5.6	-30	8.4	-55		
1 - 2 MHz	.976 - 1.4 MHz	1.95	-24	2.93	-47	1.4 - 2.0 MHz	2.8	-24	4.2	-47		
.5 - 1 MHz	488 - 700 kHz	976	-30	1.46	-55	700 - 1000 kHz	1.4	-30	2.1	-55		
250 - 500 kHz	244 - 350 kHz	488	-23	732	-47	350 - 500 kHz	700	-23	1.05	-47		
125 - 250 kHz	122 - 175 kHz	244	-24	366	-47	175 - 250 kHz	350	-24	525	-47		
61 - 125 kHz	60.9 - 87.5 kHz	121.8	-19	182.7	-37	87.5 - 125 kHz	175	-19	20.5	-37		

*Cutoff frequency of each filter is at the -2 dB point.

Note

In the event adjustment is required, the low pass filter must be removed from the Extender and placed on the bench for access to the tuning slugs. To do this, the Extender front panel must be taken off and the RANGE switch shaft removed. The 1/4 inch shaft may be inserted in the switch wafers for changing bands once the filter is on the bench.

h. Tune the H-P 606 to the second and third harmonics. The required response at these frequencies is indicated in table 4-4. If second harmonic does not meet the specifications listed, adjust L36, L37, and L38 while tuned to the second harmonic frequency. Then repeat step g. It should be between -0.5 and -0.2 dB down from the reference.

i. Tune the H-P 606 up to 30 MHz to check that there are no peaks above -40 dB in the rejection band.

j. Repeat the entire procedure for each high-end filter range, referring to table 4-4 for cut-off frequencies and harmonic response. If adjustment is required, refer to figure 5-6 to determine the proper coils to adjust.

Note

Some coils do not have slugs for tuning. These are adjusted by spreading or compressing the turns slightly.

k. Connect the +6 volt supply to A4J3-3 for low-end filter testing. Repeat the procedure for each low-end filter, referring to table 4-4 for cut-off frequencies and harmonic response. If adjustment is required, refer to figure 5-7 to determine the proper coils to adjust.

l. On the SG-1000, set the dBm switch at +20 dBm attenuation.

m. On SG-1000 connect a 50 ohm load at the RF OUT jack and monitor the output voltage with the 91-C RF voltmeter.

n. On SG-1001 forward right side remove two captive screws; remove two captive screws on forward left side. Remove C ring on rear of retaining shaft. Remove screws at rear of dust cover. Pull unit forward from case.

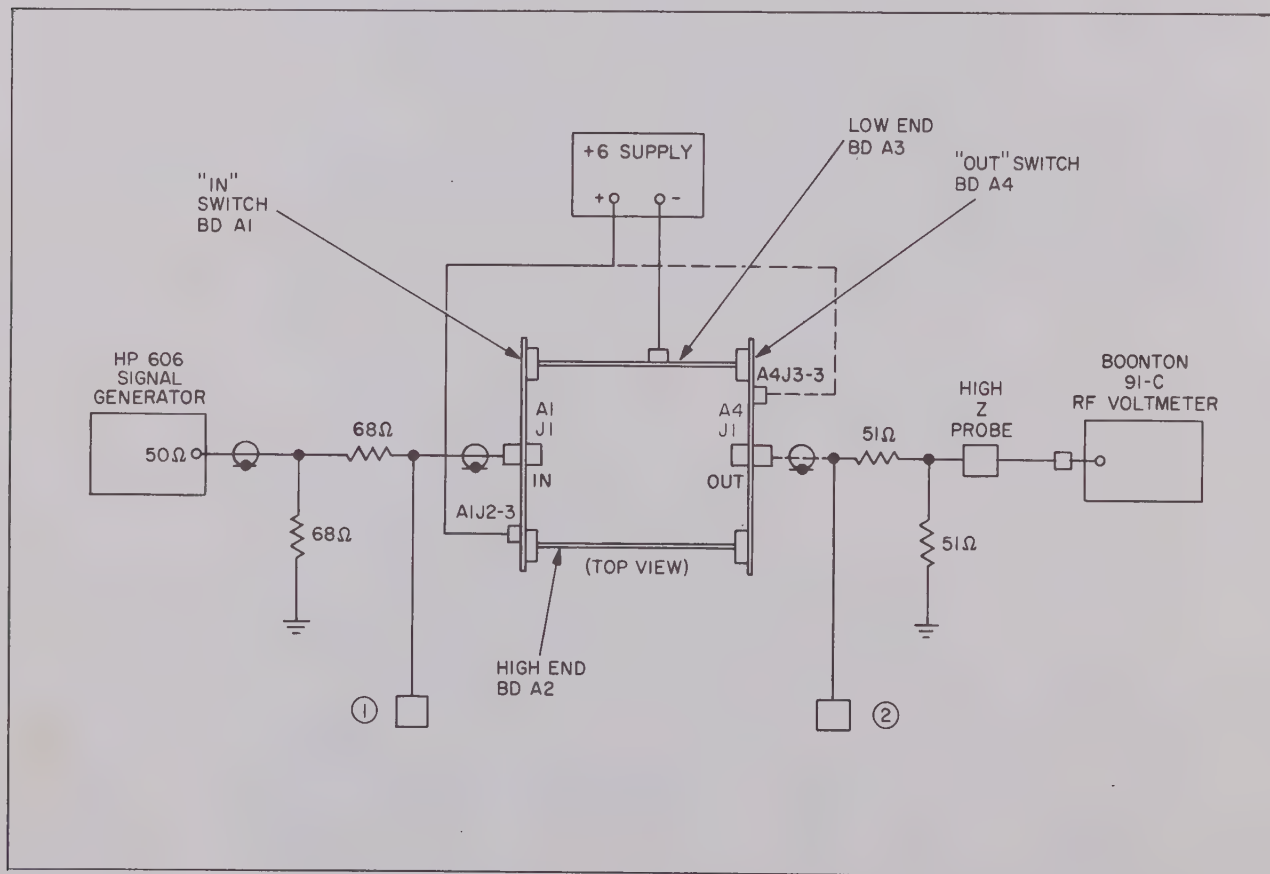


Figure 4-10. Low Pass Filter A4 Test Setup

o. On SG-1000 set dBm 50 Ω control fully CCW. On SG-1001 adjust modulator balance potentiometer A3R10 (figure 4-6) to obtain the minimum output, no greater than -25 dB.

p. Disconnect test equipment. Replace SG-1001 in case. Replace C ring and screws; tighten all screws.

4-15. CALIBRATION PROCEDURE.

4-16. Calibrate the SG-1000 as follows:

a. On the SG-1000, set the dBm switch at +20 dBm attenuation.

b. Connect a 50 ohm load at the RF OUT jack and monitor the output voltage with the 91-C RF voltmeter.

c. On SG-1000 set dBm 50 Ω control fully CW.

d. On SG-1001 adjust POWER OUTPUT ADJ (figure 4-2) for an output level of +20 dBm.

e. On SG-1001 adjust METER CAL (figure 4-2) for 0 dB on the RF LEVEL meter on the SG-1000.

f. On SG-1001 set RANGE switch to 3.9-8.0 MHz.

g. On SG-1000 turn FREQUENCY knob to 7.75 MHz; depress 400 Hz or 1 kHz pushbutton and AM pushbutton. Connect oscilloscope to SG-1000 RF OUT jack.

h. On SG-1000 set AM LEVEL to 70 percent as indicated on % AM meter. Adjust PERCENT MOD ADJ on SG-1001 for 66 percent AM as indicated on oscilloscope.

Note

The 4% offset compensates for nonlinearities in all bands and ensures $\pm 5\%$ of full scale accuracy.

i. On SG-1001 set RANGE switch to .98-2.0 MHz. Oscilloscope reading should be within 5 of the SG-1000 % AM meter indication.

j. On SG-1000 set AM LEVEL to 30 percent as indicated on % AM meter. Oscilloscope reading should be within 5 of the SG-1000 % AM meter indication.

k. On SG-1001 set RANGE switch to 3.9-8.0 MHz. Oscilloscope reading should be within 5 of the SG-1000 % AM meter indication.

l. Disconnect test equipment.

4-17. VOLTAGE MEASUREMENTS.

4-18. Operating power for the Extender is obtained from the SG-1000 main frame. The distribution of power within the Extender may be checked from information on the Interconnection Diagram, figure 5-1. Voltage measurements for all circuit board assemblies in the Extender are provided in tables 4-5 through 4-8. All measurements were taken with respect to chassis ground, using a vtvm.

TABLE 4-5. BANDSWITCH BOARD A1 VOLTAGE MEASUREMENTS

Reference Designation	Transistor Type	Terminal Voltages		
		Emitter	Collector	Base
A1Q1	2N4275	+ .25	+2.5	+ .9
A1Q2	2N5133	0	+6	0
A1Q3	2N4916	+ .4	+6	+6.1
A1Q4	2N4916	+6	+6	+5.3
A1Q5	2N5183	0	+ .1	+ .6
A1Q6	2N5183	0	+12	0
A1Q7	2N5183	0	+12	0
A1Q8	2N4916	+12	+11.1	+11.1
A1Q9	2N4916	+12	-4.92	+11.8
A1Q10	2N4916	+12	-4.92	+11.8

Note: Measurements were taken in the low end of the 4 - 8 MHz band.

TABLE 4-6. FREQUENCY DIVIDER BOARD A2 VOLTAGE MEASUREMENTS

Reference Designation	Transistor Type	Terminal Voltages		
		Emitter	Collector	Base
A2Q1	2N4275	+ .3	+5.9	+1

Note: Output to the modulator is .5 volts p-p at the selected frequency.

TABLE 4-7. MODULATOR AND POWER AMPLIFIER BOARD A3
VOLTAGE MEASUREMENTS

Reference Designation	Resistor Type	Terminal Voltages		
		Emitter	Collector	Base
A3Q2	2N4275(2x)	-1.75	+10.4	-1.1
A3Q3	2N4275(2x)	-1.75	+12	-1.1
A3Q4	2N4916	+11	-1.9	-1
A3Q5	2N3641	-2.5	+12	-1.9
A3Q6	2N5189	-3.1	+11.8	-2.5
A3Q7	2N4275	+4	+12	+4.6
A3Q8	2N4121	+4.6	-5.2	+4
MC1	MC1596 G	Pin 6, +9	Pin 9, +9	
Note: The above DC voltages are measured without a signal input. The following are measured with .5v p-p at the input to A1R1.				
A3Q2	2N4275(2x)			1 p-p
A3Q4	2N4916		4.4 p-p	
A3Q5	2N3641			4.4 p-p
A3Q6	2N5189		17 p-p	
A3Q7	2N4275	13 p-p		
A3Q8	2N4121			13 p-p
MC1	MC1596	Pin 1, -1.7		
MC2	FC702	Pin 7, +5		
Junction of A1R5 and A1R6, +1.7				
Junction of A1R36 and A1CR4, -3.4				

TABLE 4-8. RF LEVEL METER BOARD A5 VOLTAGE MEASUREMENTS

Reference Designation	Transistor Type	Terminal Voltages		
		Emitter/Source	Collector/Drain	Base/Gate
A5Q1	2N5183	0	+.04	+4
A5Q2	2N5460	-.048	-.2	+.02

Note: Measurements are for an open switch.

SECTION V SCHEMATIC DIAGRAMS

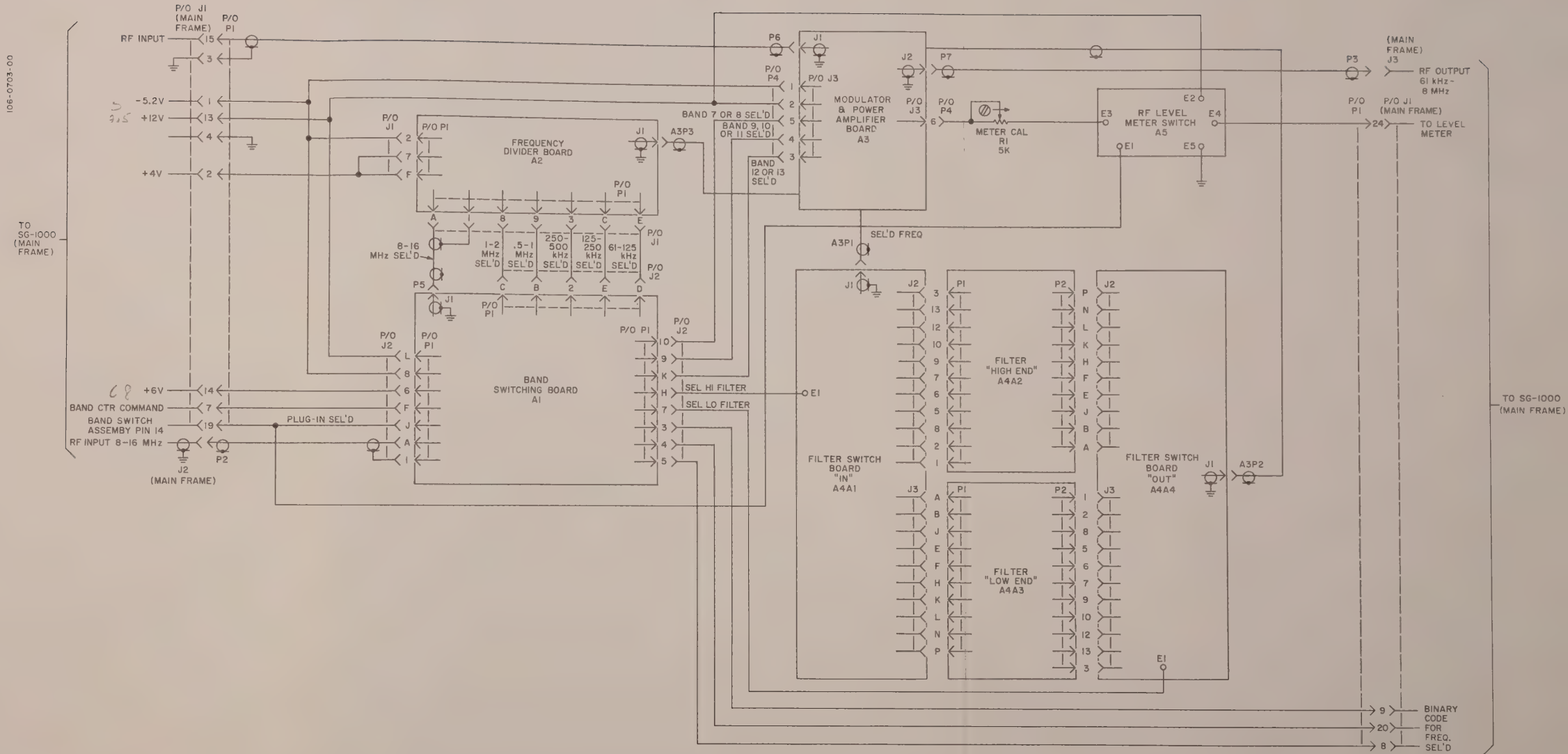
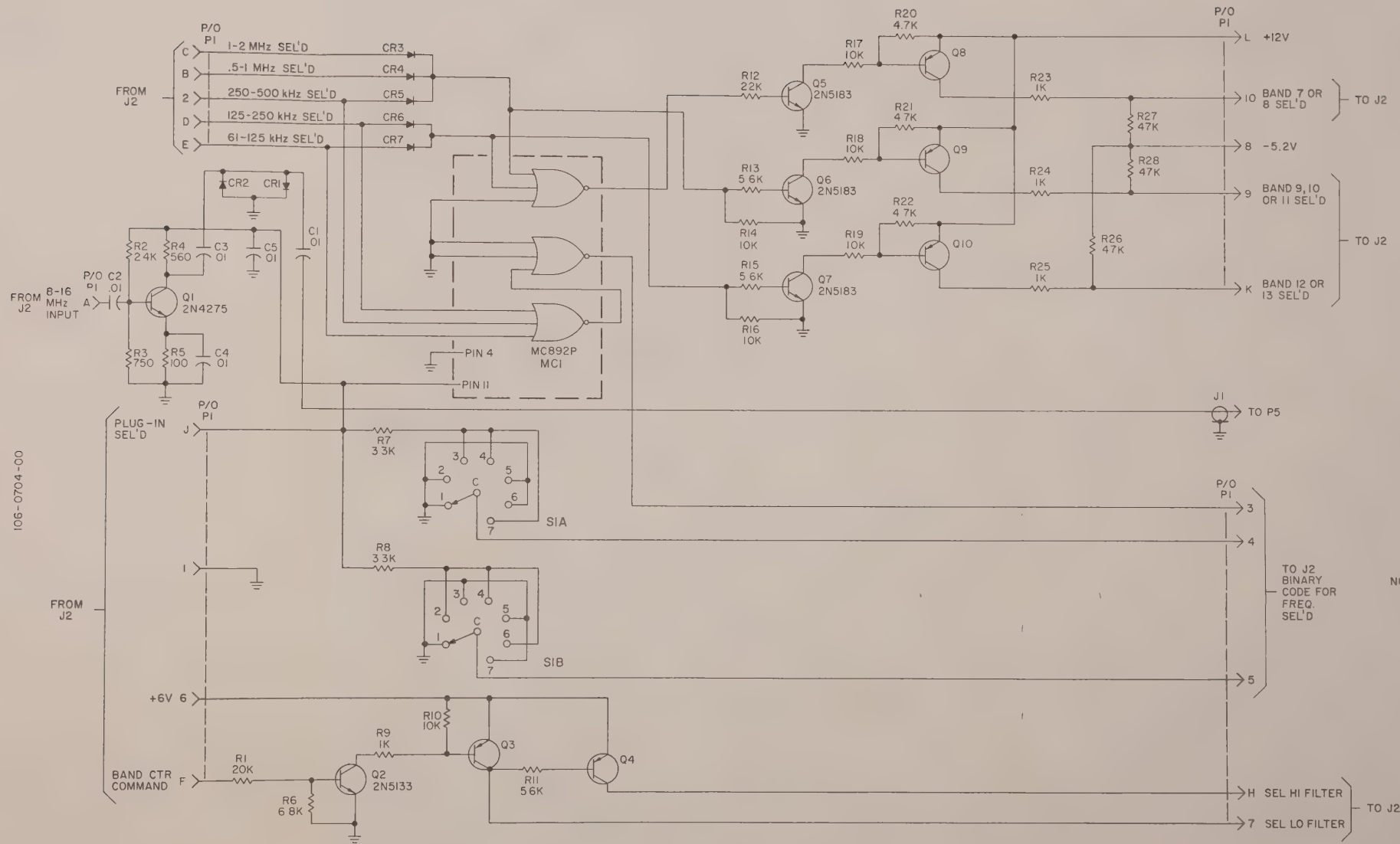


Figure 5-1. SG-1001 Interconnection Diagram



SW. CONTACT	FREQ. BAND	SW LOGIC P3	P4	P5
1	4-8 MHz	0	0	0
2	2-4 MHz	0	0	1
3	1-2 MHz	0	1	0
4	.5-1 MHz	0	1	1
5	250-500 kHz	1	0	0
6	125-250 kHz	1	0	1
7	61-125 kHz	1	1	0

- NOTES:
1. PREFIX ALL REFERENCE DESIGNATION WITH A1
 2. UNLESS OTHERWISE NOTED:
ALL RESISTORS ARE IN OHMS
ALL CAPACITORS ARE IN UF
ALL DIODES ARE IN4454
ALL TRANSISTORS ARE 2N4916

Figure 5-2. Band Switch Board A1

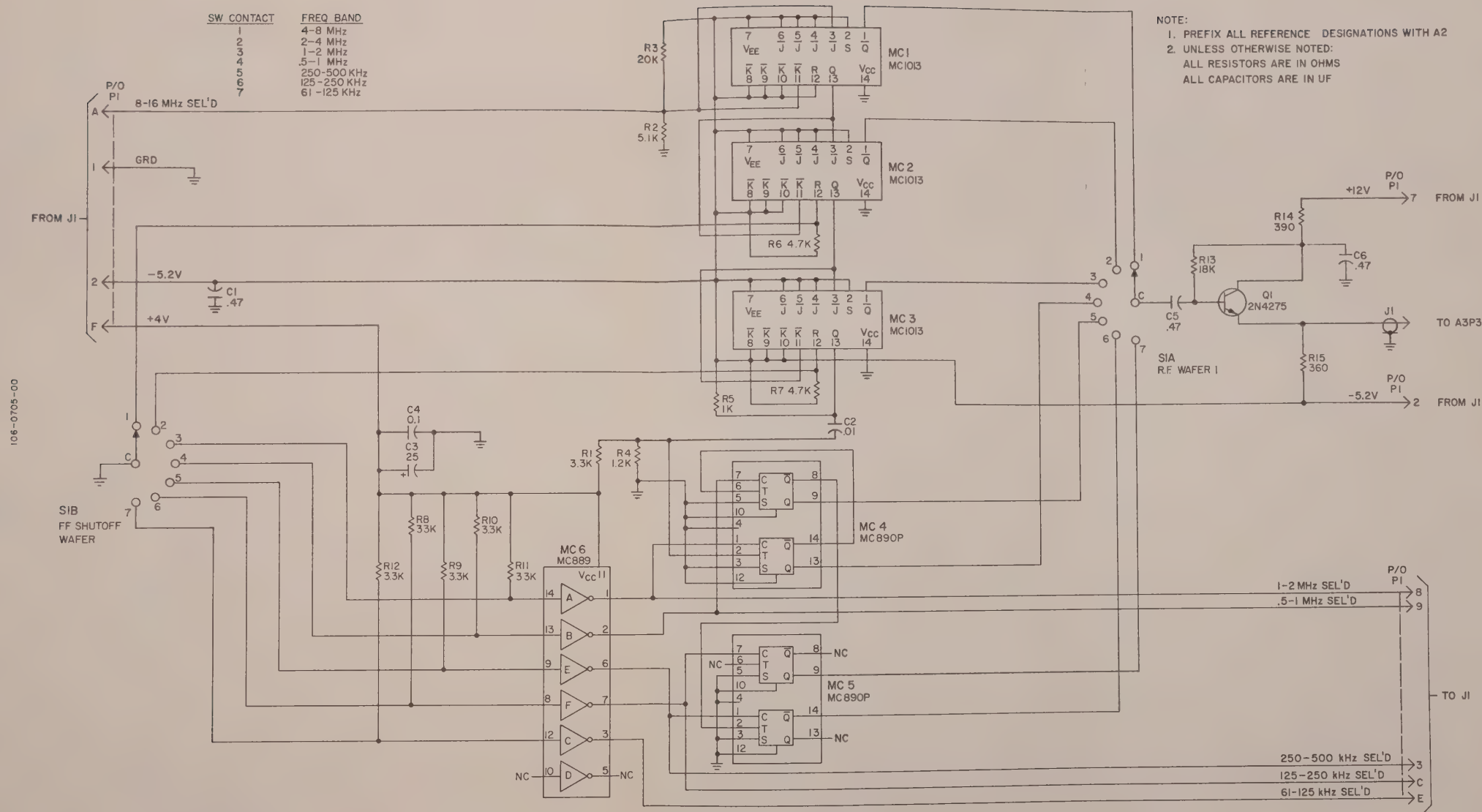
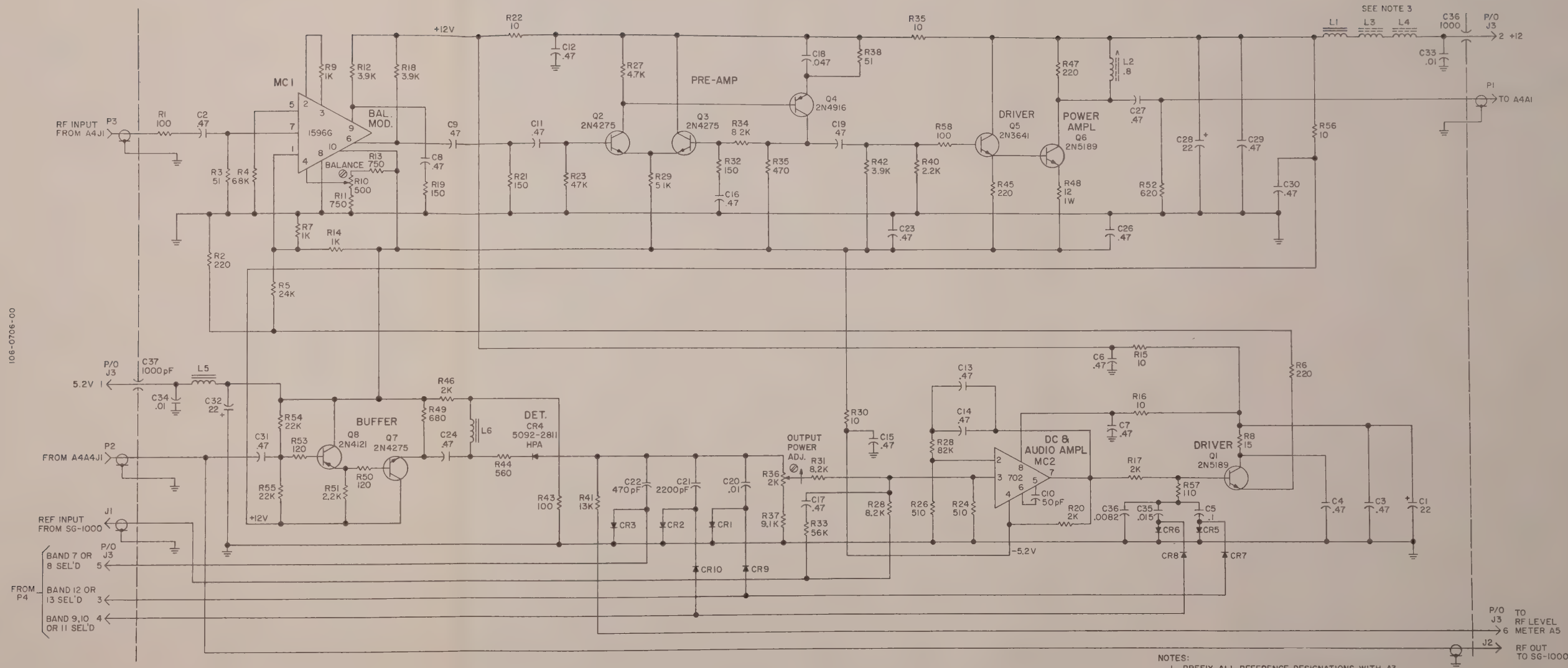


Figure 5-3. Frequency Divider Board A2



- NOTES:
1. PREFIX ALL REFERENCE DESIGNATIONS WITH A3
 2. UNLESS OTHERWISE NOTED:
ALL RESISTORS ARE IN OHMS
ALL CAPACITORS ARE IN UF
ALL INDUCTORS ARE IN mHy
ALL DIODES ARE IN4454
 3. L3 AND L4 ARE FERRITE BEADS

Figure 5-4. Modulator and Power Amplifier Board A3

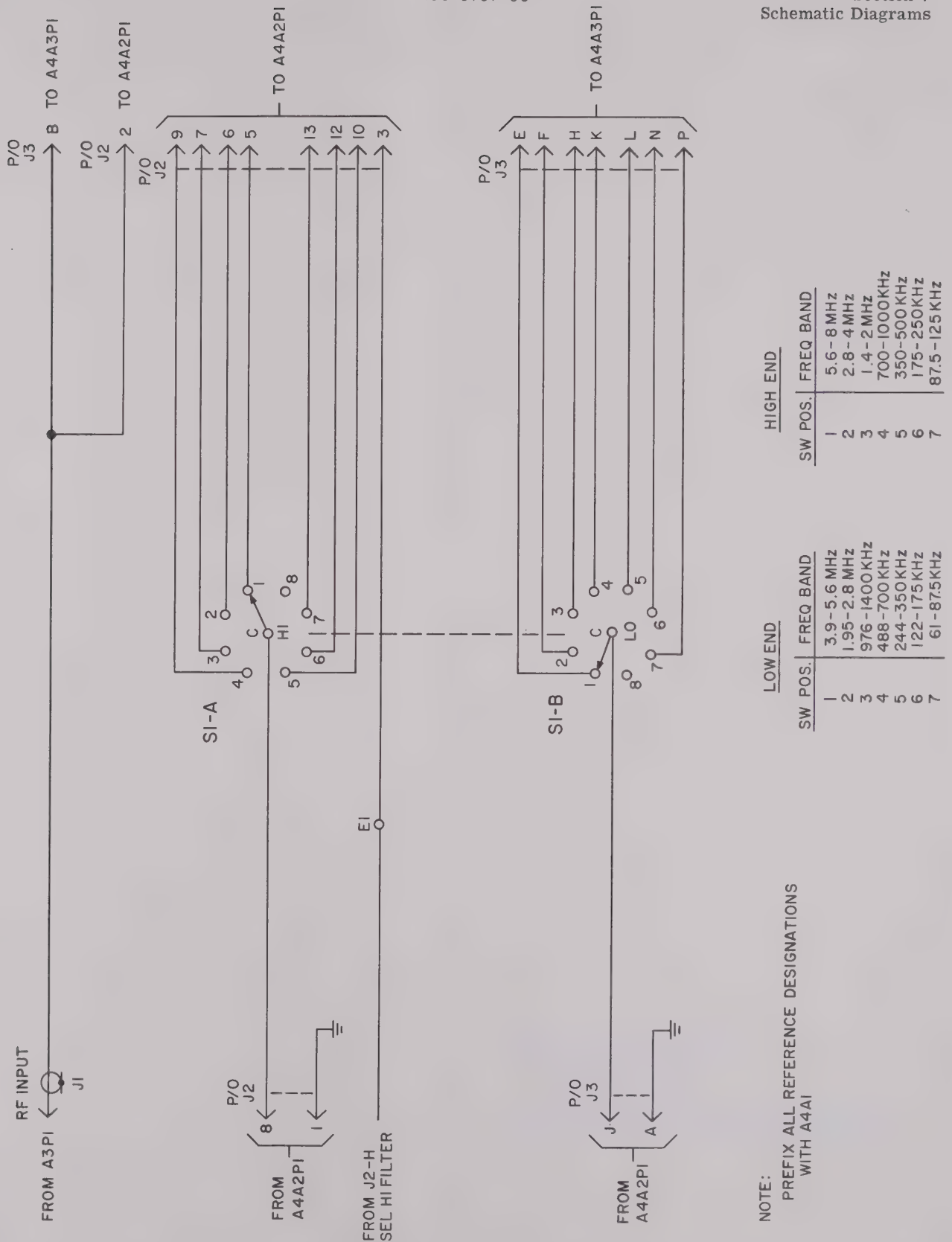
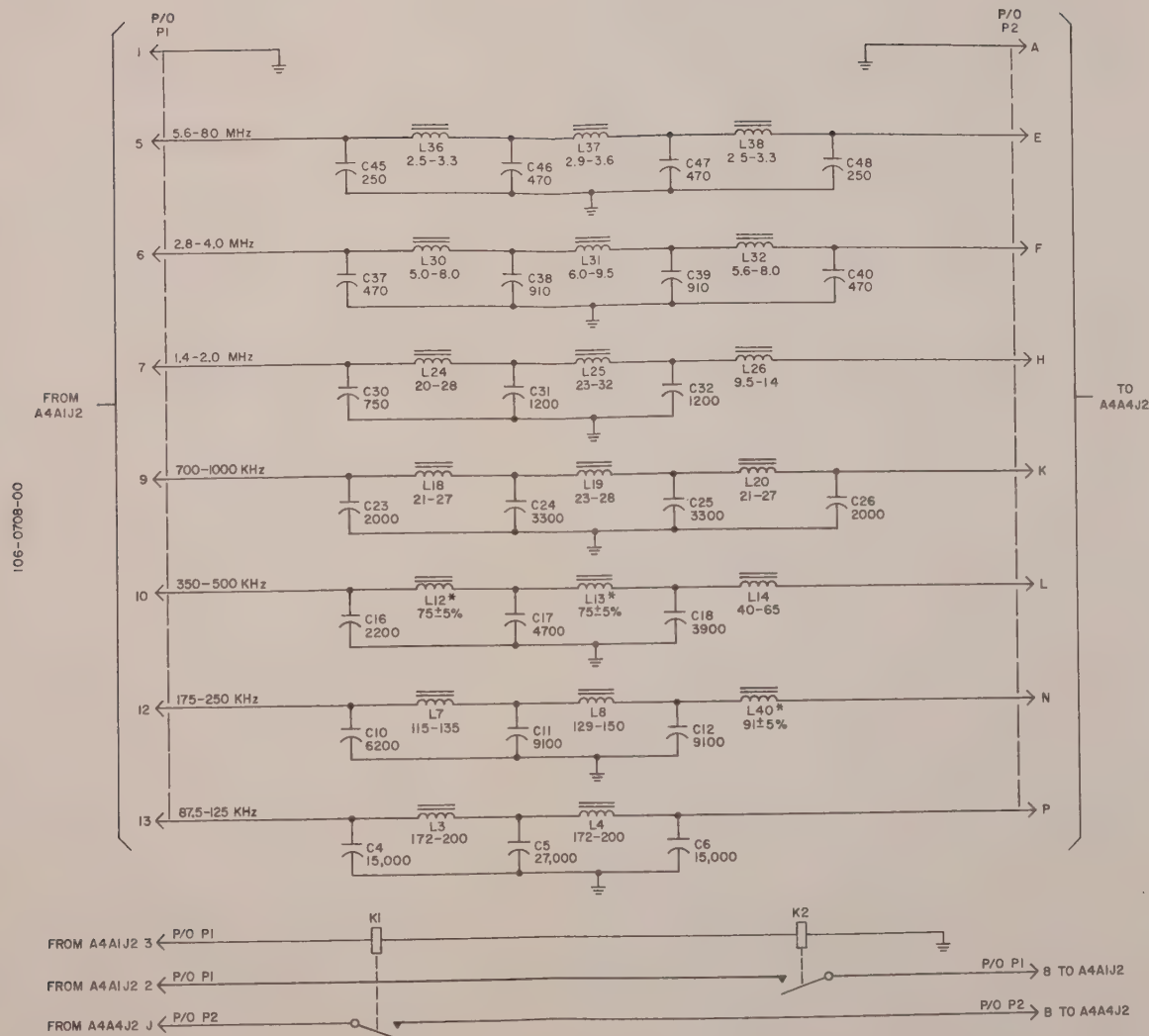


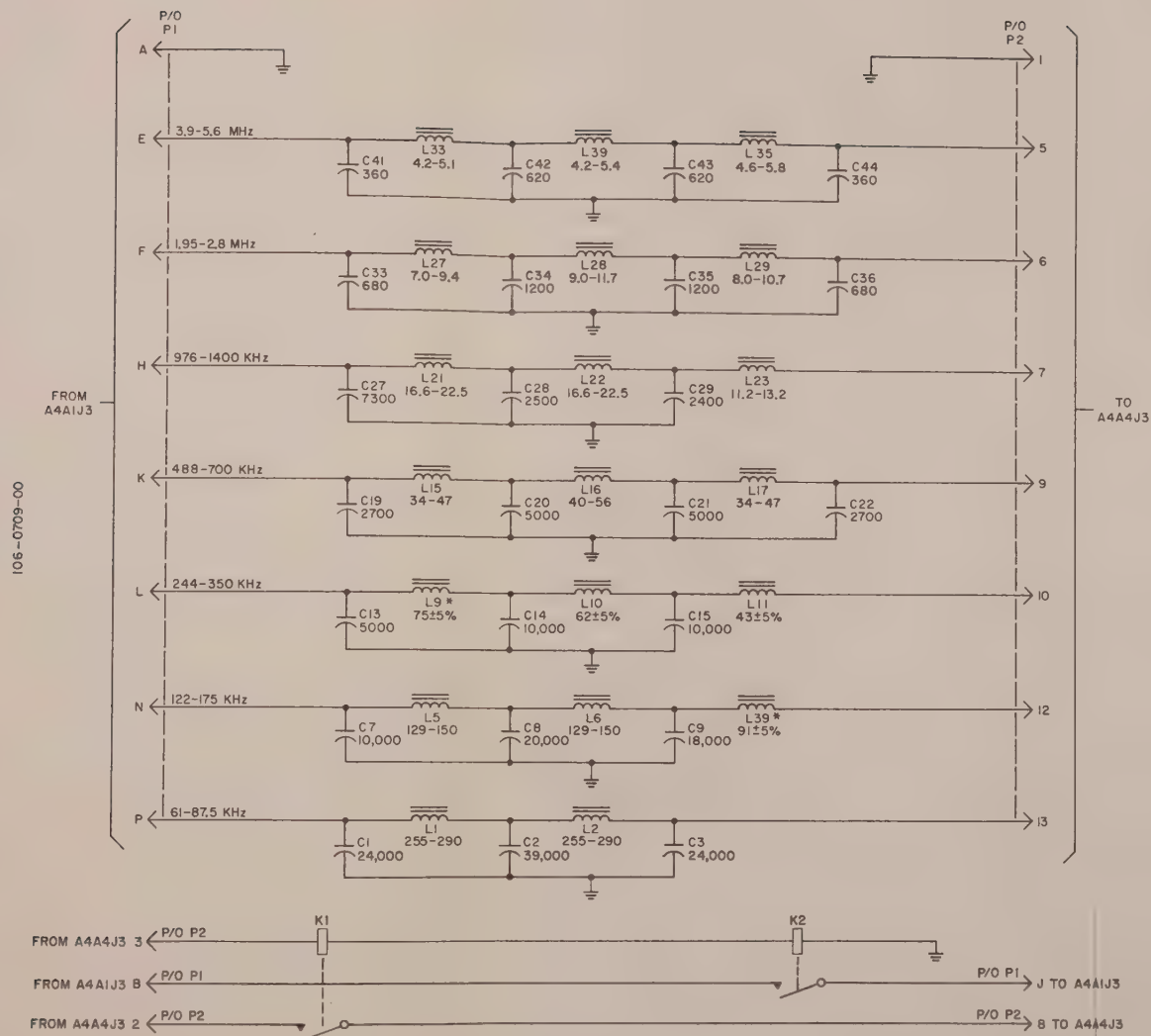
Figure 5-5. Filter Switch Board ("IN") A4A1



NOTES:

1. PREFIX ALL REFERENCE DESIGNATIONS WITH A4A2
2. UNLESS OTHERWISE NOTED:
ALL CAPACITORS ARE IN pF
ALL INDUCTORS ARE IN uH
- * 3. ALL CHOKES EXCEPT L12, L13, L40 ARE ADJUSTABLE
INDUCTANCE MEASURED WITH ALL TURNS WOUND CLOSELY

Figure 5-6. High End Low Pass
Filter Board A4A2



NOTES:

1. PREFIX ALL REFERENCE DESIGNATIONS WITH A4A3
2. UNLESS OTHERWISE NOTED:
ALL CAPACITORS ARE IN pF
ALL INDUCTORS ARE IN uH
- * 3. ALL CHOKES EXCEPT L9, L10, L11, L39 ARE ADJUSTABLE
INDUCTANCE MEASURED WITH ALL TURNS WOUND CLOSELY

Figure 5-7. Low End Low Pass
Filter Board A4A3

106-0710-00

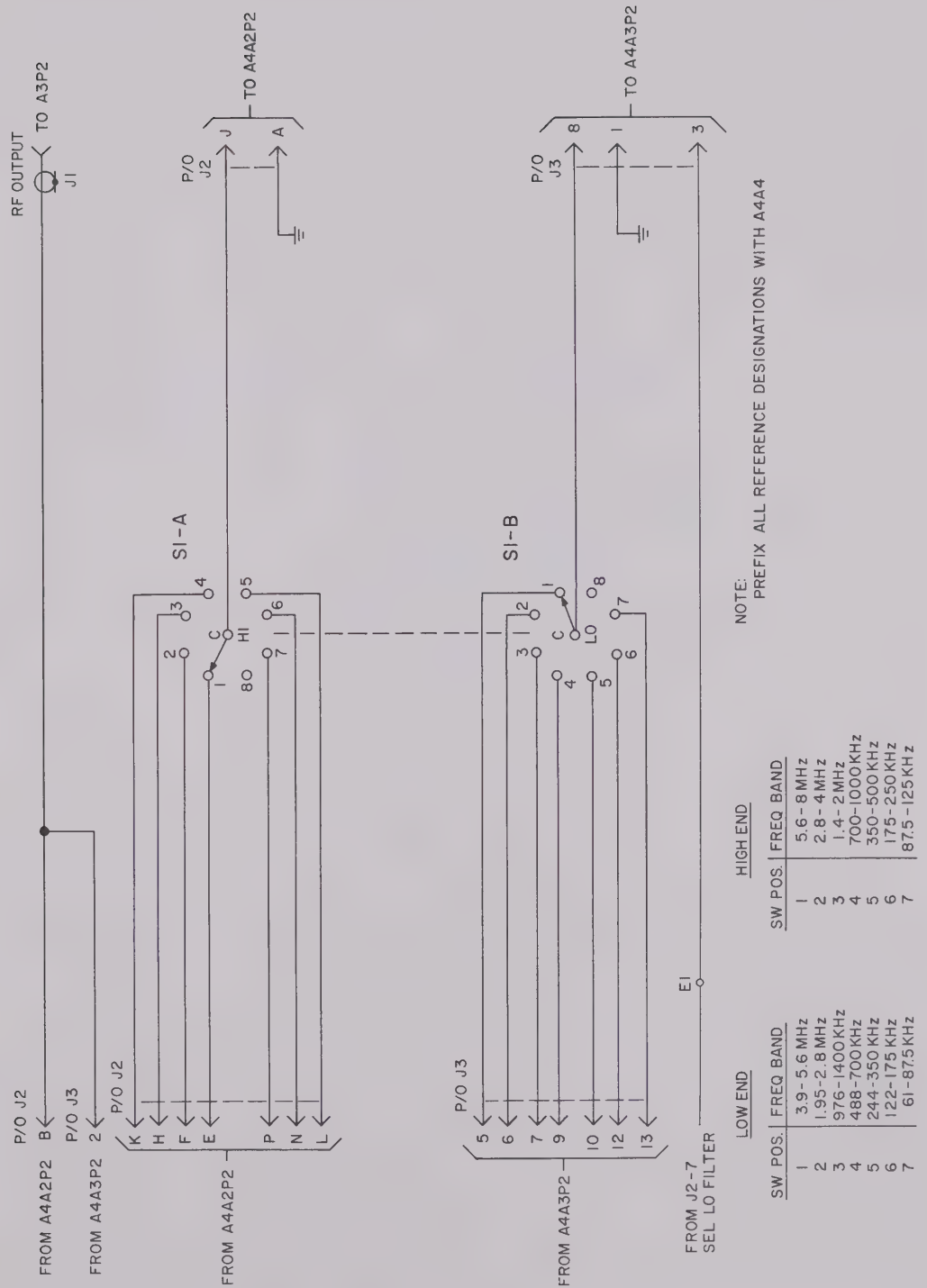


Figure 5-8. Filter Switch Board ("OUT") A4A4

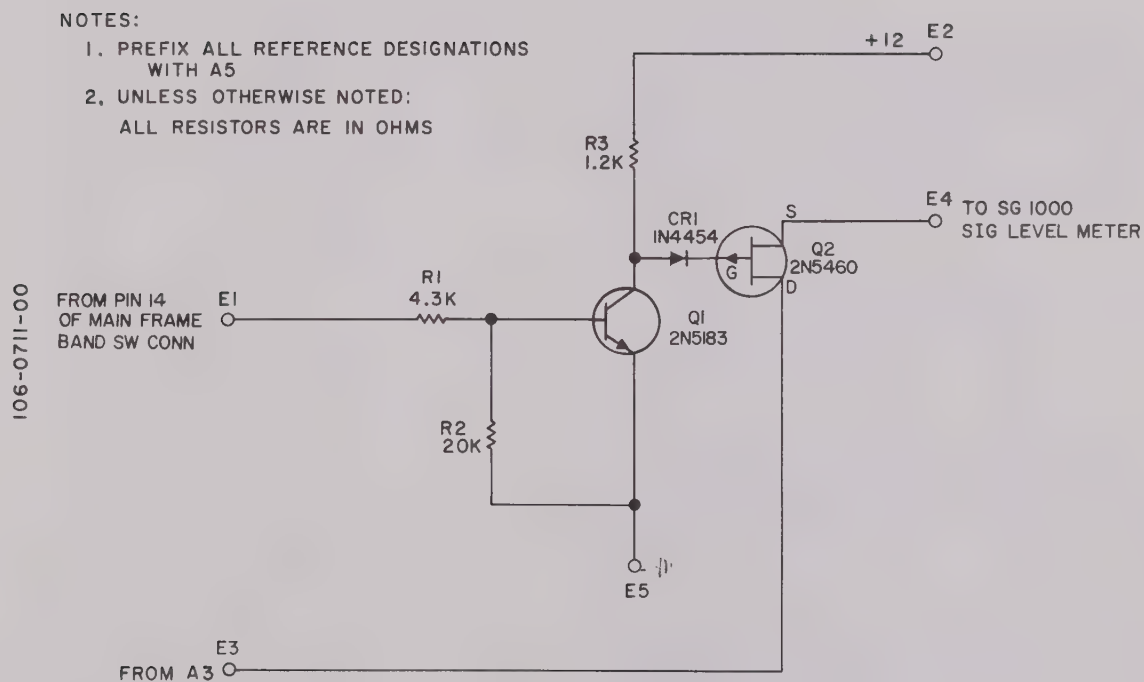


Figure 5-9. RF Level Meter Switch A5

SECTION VI PARTS LIST

6-1. INTRODUCTION.

6-2. This parts list section includes all pertinent data necessary to locate, identify, and procure additional parts for the equipment. Parts are listed alpha-numerically by reference symbol and include all replaceable items such as electronic, electro-mechanical, and mechanical parts of the equipment. In some cases, values, ratings and manufacturer sources shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement of the part(s) removed from the equipment.

6-3. ORDERING INFORMATION.

6-4. The following instructions will aid in ordering parts from the Parts List, table 6-2.

- a. Address all inquiries or orders to:

CUSTOMER SERVICE
Department 50
The Singer Company
Electronic Products Division
915 Pembroke Street
Bridgeport, Connecticut 06608

- b. Include the following information:

- 1) Model and Serial Number of instrument.
- 2) Singer Part Number.
- 3) Reference Symbol Number.
- 4) Description (as shown on list)

6-5. HOW TO USE THE PARTS LIST.

6-6. Paragraphs 6-7 through 6-11 describe the use and meaning of the five columns included in the parts list (see figure 6-1).

6-7. REF SYMBOL COLUMN. The Ref Symbol Column (1, figure 6-1) contains a alpha-numerical listing of parts as they appear on equipment chassis, illustration, or schematic. The reference designation identifies the parts as to their component function in the instrument.

6-8. DESCRIPTION COLUMN. The Description Column (2, figure 6-1) contains the identification of component parts including all pertinent specifications and Singer part number. When the description column is used for a part which is identical to a part which has already been described: SAME AS (3) is used along with the reference symbol of the previously used part. In these instances, columns 3, 4, 5, are left blank.

6-9. MANUFACTURER'S PART NUMBER COLUMN. The Manufacturer's Part Number Column (5, figure 6-1) contains the part number as designated by the manufacturer of the part.

6-10. MFR'S CODE COLUMN. The Mfr's Code column (6, figure 6-1) references the manufacturer by an assigned code number as listed in Federal Supply Code Handbook H4-2. For manufacturers not listed in H4-2, a letter code will be assigned. Table 6-1 includes the manufacturer and his code designation.

6-11. MAINT QTY COLUMN. The Maint Qty column (7, figure 6-1) contains the number of additional components recommended to keep the equipment at an optimum performance level. The recommended number of components in the Maint Qty column is based on 2000 hours of equipment operation.

Section VI
Parts List

TABLE 6-2. PARTS LIST					
REF SYMBOL	DESCRIPTION			MANUFACTURER'S PART NUMBER	MFR'S CODE
C109	CAPACITOR, ELECTROLYTIC, 20uf, MINUS 10PCT, PLUS 75PCT, 600V SINGER PART NO. 150-5004-001			D40690	56289
C110 THRU C124	SAME AS C109				
C125	NOT USED				

Figure 6-1. Parts List Sample

TABLE 6-1. MANUFACTURER'S CODE

Number	Name	Number	Name
INSTD	Industry Standard	71590	Centralab Division Globe-Union Inc. Milwaukee, Wis.
01121	Allen-Bradley Co. Milwaukee, Wis.	72136	Electro-Motive Mfg. Co., Inc. Willimantic, Conn.
02114	Ferroxcube Corp. Saugerties, N.Y.	72982	Erie Technological Products Inc. Erie, Pa.
02660	Amphenol-Borg Electronics Corp. Maywood, Ill	81312	Winchester Electronics Division Litton Industries Inc. Oakville, Conn.
04713	Motorola Inc. Semiconductor Products Division Phoenix, Arizona	86684	Radio Corp of America Electronic Components and Devices Harrison, N.J.
07263	Fairchild Camera & Instrument Corp. Semiconductor Division Mountain View, Ca.	91662	Elco Corp. Willow Grove, Pa.
11236	CTC of Berne Inc. Berne, Ind.	91737	Gremar Mfg. Co., Inc. Wakefield, Mass.
16665	The Singer Company Electronic Products Division Bridgeport, Conn.	95354	Methode Mfg. Co. Chicago, Ill.
19396	Illinois Tool Works Inc. Paktron Division Alexandria, Va.	98291	Sealectro Corp. Mamaroneck, N.Y.
28480	Hewlett-Packard Co. Palo Alto, Ca.	99800	Delevan Electronics Corp. East Aurora, N.Y.
56289	Sprague Electric Co. North Adams, Mass.		

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
J1 AND J2	CONNECTOR, PC BD, 20 CONTACTS SINGER PART NO. 168-3002-103	81-6020-1106-00	95354	2
P1	CONNECTOR, PLUG, 24 CONTACTS, MALE SINGER PART NO. 556010-114	26-159-24	02660	1
P2 AND P3	CONNECTOR, JACK, COAXIAL SINGER PART NO. 168-4069-001	11425-1/ANTI-TARN	91737	1
P4	CONNECTOR, 6 PIN SINGER PART NO. 168-0014-001	00-8129-006-605-003	91662	1
P5 THRU P7	CONNECTOR, COAXIAL, FEMALE SINGER PART NO. 556205-007	51-011-0000	98291	1
R1	RESISTOR, VARIABLE, COMP, LINEAR 10K OHMS PORM 20 PCT, 0.5W SINGER PART NO. 151-0001-041	6827	01121	1
A1	BAND SWITCHING BOARD	103-1976-001	16665	1
A1CR1 THRU A1CR7	DIODE, SILICON SINGER PART NO. 154-3001-001	1N4454	INSTD	1
A1C1 THRU A1C5	CAPACITOR, FIXED, CERAMIC DISC, 0.01 UF PLUS 60 MINUS 40 PCT, 250 VDC SINGER PART NO. 556060-146	DA140-172B	71590	1
A1J1	CONNECTOR, COAXIAL, MALE SINGER PART NO. 556205-001	51-051-0000	98291	1
A1MC1	INTEGRATED CIRCUIT, TRIPLE 3-INPUT GATE SINGER PART NO. 556147-095	MC892P	04713	1
A1Q1	TRANSISTOR, NPN, SILICON SINGER PART NO. 153-3010-001	2N4275	07263	1
A1Q2	TRANSISTOR, NPN, SILICON SINGER PART NO. 153-3009-001	2N5133	INSTD	1
A1Q3 AND A1Q4	TRANSISTOR, PNP, SILICON SINGER PART NO. 556147-059	2N4916	07263	1
A1Q5 THRU A1Q7	TRANSISTOR, NPN, SILICON SINGER PART NO. 153-3003-001	2N5183	INSTD	1
A1Q8 THRU A1Q10	SAME AS A1Q3			
A1R1	RESISTOR, FIXED, COMP, 20K OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-203J	CB2035	01121	1
A1R2	RESISTOR, FIXED, COMP, 2400 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-242J	CB2425	01121	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1R3	RESISTOR, FIXED, COMP, 750 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-751J	CB7515	01121	1
A1R4	RESISTOR, FIXED, COMP, 560 OHMS, PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-561J	CB5615	01121	1
A1R5	RESISTOR, FIXED, COMP, 100 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-101J	CB1015	01121	1
A1R6	RESISTOR, FIXED, COMP, 6800 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-682J	CB6825	01121	1
A1R7 AND A1R8	RESISTOR, FIXED, COMP, 3300 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-332J	CB3325	01121	1
A1R9	RESISTOR, FIXED, COMP, 1K OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-102J	CB1025	01121	1
A1R10	RESISTOR, FIXED, COMP, 10K OHMS, PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-103J	CB1035	01121	1
A1R11	RESISTOR, FIXED, COMP, 5600 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-562J	CB5625	01121	1
A1R12	RESISTOR, FIXED, COMP, 22K OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-223J	CB2235	01121	1
A1R13	SAME AS A1R11			
A1R14	SAME AS A1R10			
A1R15	SAME AS A1R11			
A1R16 THRU A1R19	SAME AS A1R10			
A1R20 THRU A1R22	RESISTOR, FIXED, COMP, 4700 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-472J	CB4725	01121	1
A1R23 THRU A1R25	SAME AS A1R9			
A1R26 THRU A1R28	RESISTOR, FIXED, COMP, 47K OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-473J	CB4735	01121	1
A1S1	SWITCH WAFER, 7 POSITION	133-0108-001	16665	1
A2	FREQUENCY DIVIDER BOARD	103-1971-001	16665	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A2C1	CAPACITOR, FIXED, CERAMIC, 0.47 UF PORM 20 PCT, 25 VDC SINGER PART NO. 556120-160	5C11	56289	3
A2C2	SAME AS A1C1			
A2C3	CAPACITOR, FIXED, ELECTROLYTIC, 25 UF PLUS 75 MINUS 10 PCT, 15 VDC SINGER PART NO. 150-5001-250DS	TE-1157.1	56289	1
A2C4	CAPACITOR, FIXED, CERAMIC, 0.1 UF PORM 20 PCT, 25 VDC SINGER PART NO. 556120-162	5C023104X0250B3	56289	1
A2C5 AND A2C6	SAME AS A2C1			
A2J1	SAME AS A1J1			
A2MC1 THRU A2MC3	INTEGRATED CIRCUIT, AC-COUPLED J-K FLIP-FLOP SINGER PART NO. 153-7003-001	MC1013P	04713	1
A2MC4 AND A2MC5	INTEGRATED CIRCUIT, DUAL J-K FLIP-FLOP SINGER PART NO. 556147-094	MC890P	04713	1
A2MC6	INTEGRATED CIRCUIT, HEX INVERTER SINGER PART NO. 556147-093	MC889P	04713	1
A2Q1	SAME AS A1Q1			
A2R1	SAME AS A1R7			
A2R2	RESISTOR, FIXED, COMP, 5100 OHM PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-512J	CB5125	01121	1
A2R3	SAME AS A1R1			
A2R4	RESISTOR, FIXED, COMP, 1200 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-122J	CB1225	01121	1
A2R5	SAME AS A1R9			
A2R6 AND A2R7	SAME AS A1R20			
A2R8 THRU A2R12	SAME AS A1R7			
A2R13	RESISTOR, FIXED, COMP, 18K OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-183J	CB1835	01121	1
A2R14	RESISTOR, FIXED, COMP, 390 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-391J	CB3915	01121	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A2R15	RESISTOR, FIXED, COMP, 360 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-361J	CB3615	01121	1
A2S1	SAME AS A1S1			
A3	MODULATOR AND POWER AMPLIFIER BOARD	103-2052-001	16665	1
A3C33 AND A3C34	CAPACITOR, FIXED, CERAMIC DISC, .01 UF PORM 80 PCT, 100 V SINGER PART NO. 556060-084	805-000X5V0103Z	72982	1
A3C36 AND A3C37	CAPACITOR, FEEDTHRU, 1000 PF SINGER PART NO. 556005-381	FA5C/1000PF W/6447	01121	1
A3J1 AND A3J2	CONNECTOR, COAXIAL, MALE SINGER PART NO. 168-4027-001	51-043-4300	98291	1
A3J3	SAME AS P4			
A3L1 AND A3L2	CHOKE, FERRITE, 750 OHMS Z AT 50 MHz SINGER PART NO. 156-7005-002	VK200 10/3B	02114	1
A3P1 THRU A3P3	SAME AS P5			
A3A1	POWER AMPLIFIER PC BOARD ASSY	103-1987-001	16665	1
A3A1CR1 THRU A3A1CR3	SAME AS A1CR1			
A3A1CR4	DIODE, HOT CARRIER SINGER PART NO. 154-4003-001	HPA-5082-2811	28480	1
A3A1CR5 THRU A3A1CR10	SAME AS A1CR1			
A3A1C1	CAPACITOR, FIXED, ELECTROLYTIC, 22 UF PORM 20 PCT, 15 VDC, 18 VDC SURGE SINGER PART NO. 150-5014-001	150D226X0015B2	56289	1
A3A1C2 THRU A3A1C4	SAME AS A2C1			
A3A1C5	SAME AS A2C4			
A3A1C6 THRU A3A1C9	SAME AS A2C1			
A3A1C10	CAPACITOR, FIXED, MICA, 50 PF PORM 5 PCT, 500 VDC SINGER PART NO. 150-2002-500EJO	DM15E500JO500WV4CR	72136	1
A3A1C11 THRU A3A1C17	SAME AS A2C1			
A3A1C18	CAPACITOR, FIXED, POLYESTER, 0.047 UF PORM 10 PCT, 50 VDC SINGER PART NO. 150-1021-001	MW-400/0.047/10PCT/ LM250	19396	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A3A1C19	SAME AS A2C1			
A3A1C20	CAPACITOR, FIXED, MYLAR, .01 UF PORM 2 PCT, 100 VDC SINGER PART NO. 150-4005-103G	1MD-1-103-G	72136	4
A3A1C21	CAPACITOR, FIXED, MICA, 2200 PF PORM 2 PCT, 500 VDC SINGER PART NO. 150-2003-222FGO	DM19F222GO500WV4CR	72136	1
A3A1C22	CAPACITOR, FIXED, MICA, 470 PF PORM 2 PCT, 500 VDC SINGER PART NO. 150-2003-471FGO	DM19F471GO500WV4CR	72136	1
A3A1C23 AND A3A1C24	SAME AS A2C1			
A3A1C26 AND A3A1C27	SAME AS A2C1			
A3A1C28	SAME AS A3A1C1			
A3A1C29 THRU A3A1C31	SAME AS A2C1			
A3A1C32	SAME AS A3A1C1			
A3A1C35	CAPACITOR, FIXED, POLYESTER, 0.01 UF PORM 10 PCT, 50 VDC SINGER PART NO. 150-1021-002	MW400/0.15/10PCT/LM250	19396	1
A3A1C36	CAPACITOR, FIXED, POLYESTER, 9200 PF PORM 10 PCT, 50 VDC SINGER PART NO. 150-1022-002	MW-400	19396	1
A3A1L1	INDUCTOR, FIXED, 8.2 MH PORM 10 PCT, 480 OHMS, 63 MA SINGER PART NO. 156-7009-8R2	2534-46	99800	1
A3A1L2	CHOKE, ADJUSTABLE	132-0409-001	16665	1
A3A1MC1	INTEGRATED CIRCUIT, BALANCED MODULATOR SINGER PART NO. 153-7017-001	MC1596GW/602ACASE	04713	1
A3A1MC2	INTEGRATED CIRCUIT, HI-GAIN WIDEBAND DC AMPLIFIER SINGER PART NO. 153-7005-001	UA702G/U58770239	07263	1
A3A1Q1	TRANSISTOR, NPN, SILICON SINGER PART NO. 153-3017-001	2N5189	86684	1
A3A1Q2 AND A3A1Q3	SAME AS A1Q1			
A3A1Q4	SAME AS A1Q3			
A3A1Q5	TRANSISTOR SINGER PART NO. 556146-675	2N3641	INSTD	1
A3A1Q6	SAME AS A3A1Q1			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A3A1Q7	SAME AS A1Q1			
A3A1Q8	TRANSISTOR, PNP, SILICON SINGER PART NO. 153-3014-001	2N4121	INSTD	1
A3A1R1	SAME AS A1R5			
A3A1R2	RESISTOR, FIXED, COMP, 220 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-221J	CB2215	01121	1
A3A1R3	RESISTOR, FIXED, COMP, 51 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-510J	CB5105	01121	1
A3A1R4	RESISTOR, FIXED, COMP, 680 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-681J	CB6815	01121	1
A3A1R5	SAME AS A1R2			
A3A1R6	SAME AS A3A1R2			
A3A1R7	SAME AS A1R9			
A3A1R8	RESISTOR, FIXED, COMP, 150 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-150J	CB1505	01121	1
A3A1R9	SAME AS A1R9			
A3A1R10	RESISTOR, VARIABLE, CERMET, 500 OHMS PORM 20 PCT, 1W, SINGLE TURN SINGER PART NO. 151-0033-001	360S501B	11236	1
A3A1R11	SAME AS A1R3			
A3A1R12	RESISTOR, FIXED, COMP, 3900 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-392J	CB3925	01121	3
A3A1R13	SAME AS A1R3			
A3A1R14	SAME AS A1R9			
A3A1R15 AND A3A1R16	RESISTOR, FIXED, COMP, 10 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-100J	CB1005	01121	3
A3A1R17	RESISTOR, FIXED, COMP, 2K OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-202J	CB2025	01121	1
A3A1R18	SAME AS A3A1R12			
A3A1R19	RESISTOR, FIXED, COMP, 150 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-151J	CB1515	01121	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A3A1R20	SAME AS A3A1R17			
A3A1R21	SAME AS A3A1R19			
A3A1R22	SAME AS A1R5			
A3A1R23	SAME AS A1R26			
A3A1R24	RESISTOR, FIXED, COMP, 510 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-511J	CB5115	01121	1
A3A1R25	RESISTOR, FIXED, COMP, 82K OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-823J	CB8235	01121	1
A3A1R26	SAME AS A3A1R24			
A3A1R27	SAME AS A1R20			
A3A1R28	RESISTOR, FIXED, COMP, 8200 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-822J	CB8225	01121	1
A3A1R29	SAME AS A2R2			
A3A1R30	SAME AS A3A1R15			
A3A1R31	SAME AS A3A1R28			
A3A1R32	SAME AS A3A1R19			
A3A1R33	RESISTOR, FIXED, COMP, 56K OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-563J	CB5635	01121	1
A3A1R34	SAME AS A3A1R28			
A3A1R35	RESISTOR, FIXED, COMP, 470 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-471J	CB4715	01121	1
A3A1R36	RESISTOR, VARIABLE, CERMET, 2K OHMS PORM 1 PCT, 1W, SINGLE TURN SINGER PART NO. 151-0033-003	3605202B	11236	1
A3A1R37	RESISTOR, FIXED, COMP, 9.1K OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-912J	CB9125	01121	1
A3A1R38	RESISTOR, FIXED, COMP, 51 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 150-1002-510J	CB5105	01121	1
A3A1R39	SAME AS A3A1R15			
A3A1R40	RESISTOR, FIXED, COMP, 2200 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-222J	CB2225	01121	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A3A1R41	RESISTOR, FIXED, COMP, 13K OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-133J	CB1335	01121	1
A3A1R42	SAME AS A3A1R12			
A3A1R43	SAME AS A1R5			
A3A1R44	SAME AS A1R4			
A3A1R45	SAME AS A3A1R2			
A3A1R46	SAME AS A3A1R17			
A3A1R47	SAME AS A3A1R2			
A3A1R48	RESISTOR, FIXED, COMP, 12 OHMS PORM 5 PCT, 1W SINGER PART NO. 151-1004-120J	GB1205	01121	1
A3A1R49	SAME AS A3A1R4			
A3A1R50	RESISTOR, FIXED, COMP, 120 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-121J	CB1215	01121	1
A3A1R51	SAME AS A3A1R40			
A3A1R52	RESISTOR, FIXED, COMP, 620 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-621J	CB6215	01121	1
A3A1R53	SAME AS A3A1R50			
A3A1R54 AND A3A1R55	SAME AS A1R12			
A3A1R56	SAME AS A3A1R15			
A3A1R57	RESISTOR, FIXED, COMP, 110 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-111J	CB1115	01121	1
A3A1R58	SAME AS A1R5			
A4A1	FILTER SWITCH BOARD "IN"	103-2048-001	16665	1
A4A1J1	SAME AS A1J1			
A4A1J2 AND A4A1J3	CONNECTOR, PC BOARD SINGER PART NO. 556146-635	71-6015-1307-00	95354	1
A4A1L38	COIL	132-0397-016	16665	1
A4A1S1	SAME AS A1S1			
A4A2	FILTER "HIGH END"	103-2049-002	16665	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A4A2C4	CAPACITOR, FIXED, MYLAR, .015 UF PORM 2 PCT, 100 VDC SINGER PART NO. 150-4005-153G	1MD-1-153-G	72136	1
A4A2C5	CAPACITOR, FIXED, MYLAR, .027 UF PORM 2 PCT, 100 VDC SINGER PART NO. 150-4005-273G	1MD-1-273-G	72136	1
A4A2C6	SAME AS A4A2C4			
A4A2C10	CAPACITOR, FIXED, MYLAR, 6200 PF PORM 2 PCT, 100 VDC SINGER PART NO. 150-4005-622G	1MD-1-622-G	72136	1
A4A2C11 AND A4A2C12	CAPACITOR, FIXED, MYLAR, 9100 PF PORM 2 PCT, 100 VDC SINGER PART NO. 150-4005-912G	1MD-1-912-G	72136	1
A4A2C16	SAME AS A3A1C21			
A4A2C17	CAPACITOR, FIXED, MICA, 4700 PF PORM 2 PCT, 500 VDC SINGER PART NO. 150-2003-472FGO	DM19F472GO500WV4CR	72136	1
A4A2C18	CAPACITOR, FIXED, MICA, 3900 PF PORM 2 PCT, 500 VDC SINGER PART NO. 150-2003-392FGO	DM19F392GO500WV4CR	72136	1
A4A2C23	CAPACITOR, FIXED, MICA, 2000 PF PORM 2 PCT, 500 VDC SINGER PART NO. 150-2003-202FGO	DM19F202GO500WV4CR	72136	1
A4A2C24 AND A4A2C25	CAPACITOR, FIXED, MICA, 3300 PF PORM 2 PCT, 500 VDC SINGER PART NO. 150-2003-332FGO	DM19F332GO500WV4CR	72136	
A4A2C26	SAME AS A4A2C23			
A4A2C30	CAPACITOR, FIXED, MICA, 750 PF PORM 2 PCT, 500 VDC SINGER PART NO. 150-2003-751FGO	DM19F751GO500WV4CR	72136	1
A4A2C31 AND A4A2C32	CAPACITOR, FIXED, MICA, 1200 PF PORM 2 PCT, 500 VDC SINGER PART NO. 150-2003-122FGO	DM19F122GO500WV4CR	72136	1
A4A2C37	SAME AS A3A1C22			
A4A2C38 AND A4A2C39	CAPACITOR, FIXED, MICA, 910 PF PORM 2 PCT, 500 VDC SINGER PART NO. 150-2003-911FGO	DM19F911GO500WV4CR	72136	1
A4A2C40	SAME AS A3A1C22			
A4A2C45	CAPACITOR, FIXED, MICA, 250 PF PORM 2 PCT, 500 VDC SINGER PART NO. 150-2002-251EGO	DM15E251GO500WV4CR	72136	1

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A4A3K1 AND A4A3K2	SAME AS A4A2K3			
A4A3L1 AND A4A3L2	CHOKE, ADJUSTABLE	132-0408-001	16665	1
A4A3L3	COIL	132-0397-015	16665	1
A4A3L5 AND A4A3L6	CHOKE, ADJUSTABLE	132-0408-003	16665	1
A4A3L9	SAME AS A4A2L12			
A4A3L10	INDUCTOR, FIXED, 62 UF PORM 5 PCT, 3.15 OHMS 225MA SINGER PART NO. 156-7007-620	1537-66	99800	1
A4A3L11	INDUCTOR, FIXED, 43 UF PORM 5 PCT, 2.7 OHMS 242 MA SINGER PART NO. 156-7007-430	1537-58	99800	1
A4A3L15	COIL	132-0398-001	16665	1
A4A3C16	COIL	132-0398-002	16665	1
A4A3L17	SAME AS A4A3L15			
A4A3L21 AND A4A3L22	COIL	132-0397-003	16665	1
A4A3L23	COIL	132-0397-004	16665	1
A4A3L27	COIL	132-0397-008	16665	1
A4A3L28	COIL	132-0397-009	16665	1
A4A3L29	COIL	132-0397-010	16665	1
A4A3L33	COIL	132-0397-013	16665	1
A4A3L34	COIL	132-0397-014	16665	1
A4A3C39	SAME AS A4A2L40			
A4A4	FILTER SWITCH BOARD "OUT"	103-2047-001	16665	1
A4A4J1	SAME AS A1J1			
A4A4J2 AND A4A4J3	SAME AS A4A1J2			
A4A4S1	SAME AS A1S1			
A5	RF LEVEL METER SWITCH	103-2078-001	16665	1
A5CR1	SAME AS A1CR1			
A5Q1	SAME AS A1Q5			

TABLE 6-2. PARTS LIST

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A5Q2	TRANSISTOR, FET SINGER PART NO. 153-3012-001	2N5460	INSTD	1
A5R1	RESISTOR, FIXED, COMP, 4300 OHMS PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-432J	CB4325	01121	1
A5R2	SAME AS A1R1			
A5R3	SAME AS A2R4			

